INSTRUCTION MANUAL

SPECTRUM ANALYZER

MODEL ESA-1000

100 kHz - 1000 MHz

ELECTRO-METRICS
A PENRIL COMPANY

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INSTRUCTION MANUAL

FOR

SPECTRUM ANALYZER

MODEL ESA-1000

ELECTRO-METRICS

A PENRIL COMPANY

100 CHURCH ST. • AMSTERDAM, N.Y. 12010 • (518) 843-2600

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March 10, 1982

Integrand
8620 Roosevelt Avenue
Visalis, CA 93291
Attn: Bob Frank

Date: 2/9/82

Reference: 3827

We certify that the equipment in the reference P.O. was tested and inspected and found to be in conformance with the specifications of the order.

All measurements are traceable to the National Bureau of Standards.

Calibration data is maintained on file for reference as required.

Mike DiCaprio for
Donald Young
Quality Control Manager

/ks

SECTION I
Introduction and Specifications

1.1 THE MANUAL

This manual contains all relevant information for the operation, maintenance, and repair of the ESA-1000 Spectrum Analyzer.

1.2 THE ESA-1000

The ESA-1000 Spectrum Analyzer has been designed to measure electromagnetic interference (EMI) over the frequency range of 100 kHz to 1000 MHz, while retaining the ability to perform the usual spectrum analyzer applications of spectrum and waveform analysis. By incorporating CISPR IF bandwidth and Quasi-Peak detection circuits into the instrument, the electrical characteristics thus conform to the specifications and requirements set forth in various CISPR (Comite International Special des Perturbations Radio electriques) and related VDE (Verband Deutschen Elektrotechniker)-FCC mandates. The ESA-1000 can therefore be used to determine compliance to EMI conducted limits for the frequency range 100 kHz to 30 MHz and to EMI Radiated limits for the frequency range 30 MHz to 1000 MHz.

The ESA-1000 has the capability to read Electric Field strength directly since the digital indication for the reference level includes the antenna factor offset for the antenna type being utilized. The CRT Display has a full 80 dB Log range with an LED digital display indicating the center frequency the instrument is tuned to. The ESA-1000 has the capability to drive an optional X-Y recorder which produces a hard copy record of the information on the CRT Display.

A useful option for the ESA-1000 is the DM-1000 Digital Memory unit. This optional module permits a visual display on the CRT of data being acquired at the slow scan rates dictated by the CISPR Quasi-Peak time constants. The memory unit stores the data being acquired, at the slow scan rate, and then displays it on the CRT at a faster sweep rate for improved visual interpretation.

1.3 UNPACKING

1.3.1 Remove the instrument carefully from the shipping carton and examine thoroughly for shipping damage. If there is any damage, replace the instrument in the shipping carton and immediately inform the manufacturer and the shipping company of the nature of the damage, the serial number of the instrument, the delivery date, and the invoice number.

1.3.2 Check contents of the carton against the shipping slip to be sure that all components and accessory items ordered are present. Notify the manufacturer immediately of any missing items.

1.4 ELECTRONIC SHIPPING DAMAGE

Before leaving the factory, this instrument was subjected to a complete operational check. However, it is possible that electronic damage may have occurred in transit. It is desirable, therefore, to check the operation of the instrument as soon as possible after unpacking.

To do so, perform the calibration tests outlined in Section IV. If the instrument does not perform as per these instructions, inform the Electro-Metrics Customer Service Department (518) 843-2600, giving the information required in paragraph 1.3.1.

1.5 ELECTRICAL SPECIFICATIONS

The electrical and general specifications for the ESA-1000 Spectrum Analyzer are given in Table 1.1.

ESA-1000 SPECIFICATIONS

Frequency Specifications

Frequency Range: 100kHz to 1000MHz

Center Frequency Display: Unit of 1MHz, digital display by LED.

Center Frequency Display Accuracy: Within ± 10MHz.

Scan Width: By DISPERSION/DIV switch, 100MHz/Div to 100kHz/Div in 1-2-5 steps and zero scan.

Scan Linearity: Within ±5%

Tuning Mode: By Center Frequency Tuning.

Frequency Stability: Within 200kHz/5 minutes

Residual FM: Within 10kHz p-p

Noise Sidebands: -70dBc, 200kHz away from carrier with IF B.W. 10kHz.

IF Bandwidth: 300kHz, 100kHz, 30kHz, 10kHz (3dB) automatically set by Dispersion/Div. switching or 1.5MHz, 120kHz, 9kHz (6dB) manually set.

IF Bandwidth Accuracy: Within ±20%

IF Bandwidth Selectivity: 60dB/3dB IF Bandwidth ratio < 15:1

IF Bandwidth Switching Accuracy: Within ±1dB.

Amplitude Specifications

Display on CRT: Switchable to 10dB/div., 5dB/div., or LINEAR

LOG Display Accuracy: Within ± 1dB/10dB, ±1.5dB/40dB, ±2dB/80dB

Reference Level Display: 3 digits, 7-segment LED, 1dB resolution.

Reference Level Selection: Input Level (dBuV), Field Strength (dBuV/m) "A" or "B", Field Strength measurement "A" is half-wave dipole, "B" is Log periodic antenna. Respective antenna factor included in Reference Level.

Reference Level Accuracy: Within ±1.5dB.

Dynamic Range on CRT: 80dB

Average Noise Level: Below 5dBuV (at IF Bandwidth 10kHz, Video Filter 100Hz)

Spurious Response: -70dB or less (at RF ATT. 0dB, 80dBuV input)

Residual Response: Less than 20dBuV (at RF ATT. 0dB, 80dBuV input)

Video Filter: 100Hz, 10kHz, OFF switchable in MEAN Detection Mode.

Frequency Response: Within ±1dB, 100kHz to 1000MHz

IF Gain: 0 to 30dB in 10dB steps, -6dB to +6dB in 1dB steps

Gain Compression: Less than 1dB (at RF ATT. 0dB, 100dBv input)

Detection Method: Mean (Average Value) Dynamic Range 80dB and CISPR Quasi-Peak Dynamic Range 40dB.

Input Specifications

Input Connector: Type N.

Input Impedance: 50 ohms.

V.S.W.R.: Below 1.5 at RF ATT. 10dB.

Input Attenuator: 0 to 40dB in 10dB steps

Max. Permissible Input Level: 130dBuV ±50V DC

Scan Specifications

Scan Time: 20ms. to 10s continuously variable

Scan Mode: Single, Manual, Auto.

General Specifications

CRT: 94 x 75mm (scale 10 x 8) P31 phosphor

X Axis Output: Approximately ±5v, Impedance 10K ohms

Y Axis Output: Approximately 0 to 3.5V, Impedance 10K ohms

Audio Monitor Output: 8 ohms (Earphone EHF-25)

Calibration Output: Frequency: 100MHz ±200kHz
Level: 80dBuV ±0.5dB

Operational Temperature: 0°C to +40°C

Power Requirements: 115VAC ±10% 50/60Hz, consumption less than 50VA (at least 3.5 hours with BAT-1000 Battery Pack)

External Dimensions: Approximately 12" (W) x 7" (H) x 15" (D) [300 x 170 x 430mm]

Weight: Approximately 27 pounds.

ALL SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

TABLE 1.1 ESA-1000 Specifications

SECTION II
Theory of Operation

2.1 GENERAL

The following section briefly describes the major circuitry of the ESA-1000 Spectrum Analyzer. The discussion follows, as close as possible, the signal flow through the analyzer starting with the RF INPUT section. Use of the block diagrams and schematics located throughout this section and the schematics located in Section VII will be helpful in understanding the function and operation of the circuitry.

2.2 SYNOPSIS OF UNIT OPERATION

The ESA-1000 Spectrum Analyzer is a heterodyne receiver which initially upconverts the input signal (100 kHz to 1000 MHz) to 1153.3 MHz at the 1st MIXER stage for improved image signal rejection. The LO oscillator for the 1st MIXER stage comprises a YIG tuned oscillator which covers the frequency range of 1000 MHz to 2200 MHz. The 1153.3 MHz IF signal is then downconverted twice to obtain the final IF frequency of 3.3 MHz. This final IF frequency is next applied to the input of the IF Filter section.

The IF Filter section is specially designed to provide bandpass filter conditions of 3 dB and 6 dB bandwidths. The 3 dB section (when set to AUTO on the 6 dB section) comprises bandwidths of 300 kHz, 100 kHz, 30 kHz, and 10 kHz while the 6 dB section comprises bandwidths of 1.5 MHz, 120 kHz, and 9 kHz. The bandwidth is selected according to the sweep width of the IF frequency while the gain is adjustable by means of a variable gain amplifier included within the IF Filter section.

The RAMP GENERATOR circuit produces a sawtooth output which is used to sweep the X-axis of the CRT tube and the YIG tuned oscillator. For sweeping the YIG tuned oscillator, the sawtooth signal is controlled within the YIG DRIVER by the DISPERSION/DIV switch to set the sweep width between 10 MHz/DIV. and 0.1 MHz/DIV. In addition the YIG DRIVER also receives the tuning voltage input from the TUNING controls to further control the YIG tuned oscillator output.

The CENTER FREQUENCY LED readout displays the frequency set by the TUNING control by utilizing an A/D converter to convert the analog tuning voltage to an equivalent digital voltage. In a similar manner the REFERENCE LEVEL LED readout displays the total amount of attenuation added into the circuit by the RF ATTENUATOR and IF GAIN switches. In the INPUT LEVEL position of the REFERENCE LEVEL switch, the voltages derived from the RF ATTENUATOR and IF GAIN switches are summed and converted via a A/D converter to the digital voltages utilized by the LED display module. In the FIELD STRENGTH positions of the REFERENCE LEVEL switch (Antenna A or B), an antenna coefficient is calculated based on the input tuning voltage from the tuning controls and the type of antenna being utilized. This coefficient is then added to the REFERENCE LEVEL reading.

2.3 CIRCUITRY DESCRIPTION

2.3.1 DC BLOCKING CIRCUIT

This is simply a capacitor inserted between the INPUT connector and the RF ATTENUATOR to block the DC component of an input signal.

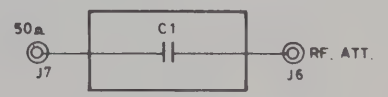

Figure 2.1 DC Blcoking CKT

2.3.2 RF ATTENUATOR CIRCUIT

The RF ATTENUATOR assembly comprises a series of thin film resistors which forms a 10 dB step attenuator with a range of 40 dB.

2.3.3 RADIO FREQUENCY SECTION (RF) BLOCK)

The RF section utilizes a two stage frequency converter to convert the RF input signal from the RF ATTENUATOR into an IF frequency of 46.7 MHz. This section comprises a 1st IF MIXER (Assembly SX052), a 2nd IF MIXER (Assembly SX053) and four tuned cavities.

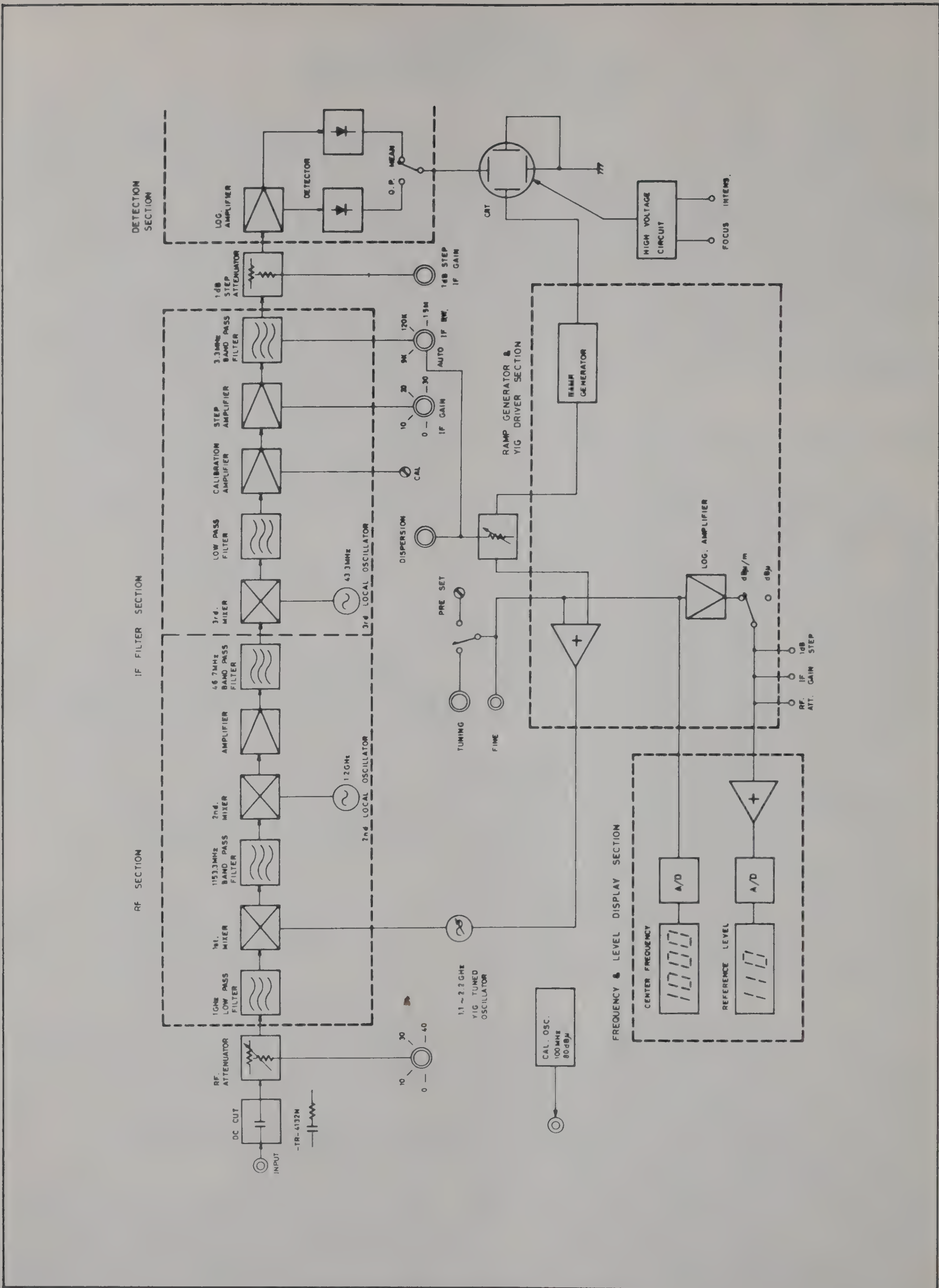

Figure 2.2 ESA-1000 Block Diagram

The input signal from the RF ATTENUATOR is applied to the 1st MIXER stage along with the 1st LO frequency to produce the 1st IF frequency of 1153.3 MHz. The 1st IF frequency then goes via a three stage Band Pass Filter, cavity tuned to 1153.3 MHz, to the 2nd IF MIXER.

The 1st MIXER comprises a strip line low pass input filter with a cutoff frequency of 1 GHz feeding a balanced mixer which minimizes LO feed-through.

The 2nd IF MIXER uses a cavity tuned oscillator to produce the 2nd LO frequency of 1200 MHz. The 1st IF frequency of 1153.3 MHz is loop-coupled to the 2nd LO cavity and then both are applied to a balanced mixer.

The 2nd IF MIXER produces the 2nd IF frequency of 46.7 MHz (difference of 1200 MHz LO and 1153.3 IF) and is applied to a low pass filter composed of C27 and L41. It is then amplified by Q2 and applied to the input of the IF Filter. The conversion gain for the RF section is from -0.1 dB to +1.0 dB for a 50 ohm load.

2.3.4 IF FILTER SECTION

The IF FILTER section receives the 46.7 MHz IF signal from the RF section, downconverts it to 3.3 MHz, and finally passes it through a four stage band pass filter.

The 46.7 MHz 2nd IF signal from the RF section is supplied via a four stage fixed component bandpass filter to the 3rd IF MIXER stage. The 2nd IF signal is then mixed in a balanced mixer with a 3rd LO frequency of 43.4 MHz. The resultant 3.3 MHz final IF frequency is then applied to a low pass filter composed of C205, L309, and C206.

A variable gain amplifier (composed of Q2 and Q3, see Figure 2.4), controlled by adjustment R79 (GAIN CORRECT), compensates for the IF conversion loss. The front panel CAL adjustment, which controls the bias voltage level on Q3, is used to adjust the amplitude level on the CRT and has a nominal gain range of approximately 4 dB.

Transistors Q4 to Q7 form a 20 dB variable gain amplifier, while transistors Q10 to Q13 form a buffer amplifier with a gain of 10 dB. When the outer section of the front panel IF GAIN switch is set to either the 10 dB or 20 dB position, the gain of the variable amplifier is set to 10 dB or 20 dB depending upon the switch position. In the 30 dB position, the fixed gain 10 dB buffer amplifier is added into the circuit.

The filter section is comprised of a four stage active component band pass filter (comprised of Q8, Q9, Q14, Q15) plus a crystal filter utilized in conjunction with Q16. The center frequency of each stage and the crystal filter is 3.3 MHz. As the front panel 6 dB BANDWIDTH switch is switched, a diode switch in each stage is turned on according to the switch position. This changes the Q of the respective bandpass stage LC resonate circuit which selects a 6 dB bandwidth of 1.5 MHz, 120 kHz, or 9 kHz. The 1.5 MHz bandwidth is determined by the 46.7 MHz band pass filter in front of the 3rd IF MIXER stage. The 120 kHz bandwidth is set by the LC circuits in the crystal filter stage, while the 9 kHz bandwidth is set by placing the crystal filter in series with the LC filter. When the front panel BANDWIDTH switch is set to the AUTO position, bandwidth is controlled by the setting of the DISPERSION/DIV. switch fora 3 dB bandwidth of 300 kHz, 100 kHz, 30 kHz, or 10 kHz. Variation in amplitude level due to the BANDWIDTH switch can be compensated by adjusting R152 (30 kHz – GAIN ADJ.) or R127 (10 kHz – GAIN ADJ.). Transistor Q17 and Q18 form an output amplifier circuit.

The conversion loss through the IF FILTER is approximately 9 dB with the outer section of the IF GAIN switch set to the 0 dB position and the inner section set to the CAL position.

2.3.5 1 dB STEP ATTENUATOR

A 1 dB step attenuator with a range of 12 dB located between the IF FILTER and Log Amplifier section. When the inner section of the front panel IF GAIN switch is set to the CAL position, the attenuation value is 6 dB.

2.3.6 LOG AMPLIFIER SECTION

The Log Amplifier utilized in the ESA-1000 is coincidence-phase saturation amplifier with a gain of 10 dB and nine stages connected in cascade. An approximate value amplifier is formed when the outputs of the four front stages and the rear five stages are summed respectively then added together.

When setting either the Vertical Axis Scale Selector switch to the LINEAR position or the DETECTION MODE switch to the Q.P. (Quasi-Peak) position, the input signal passing through the four front stage amplifiers is amplified in the circuit formed by Q37 and Q38 and then supplied to the detector circuit. If the Vertical Axis Scale Selector switch is set to either the 10 dB/DIV. or 5 dB/DIV. (LOG) positions and the DETECTION MODE switch is set to the MEAN (AVERAGE) position,

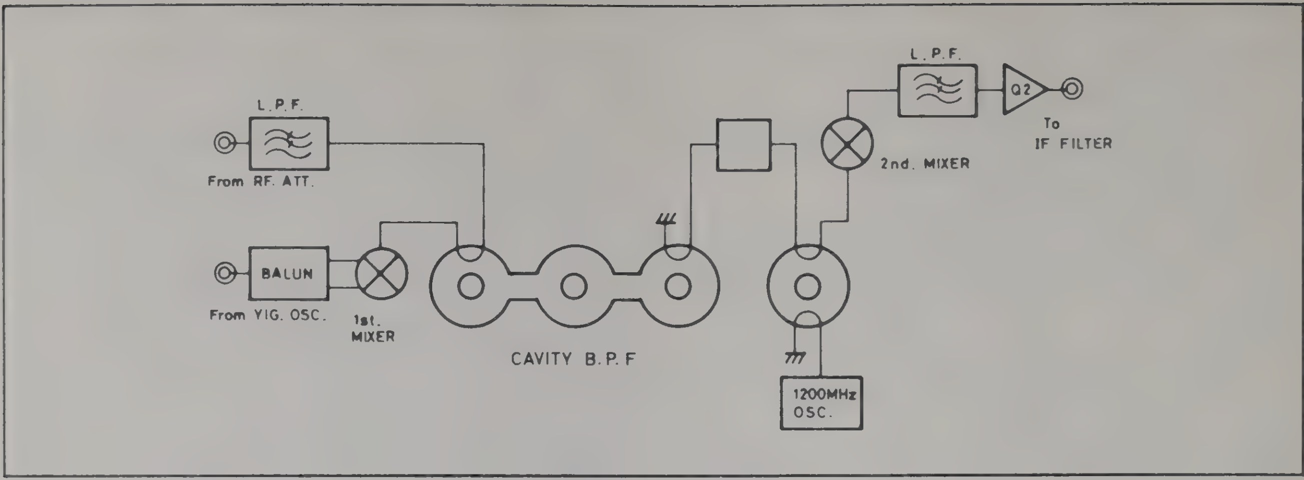

Figure 2.3 RF Section

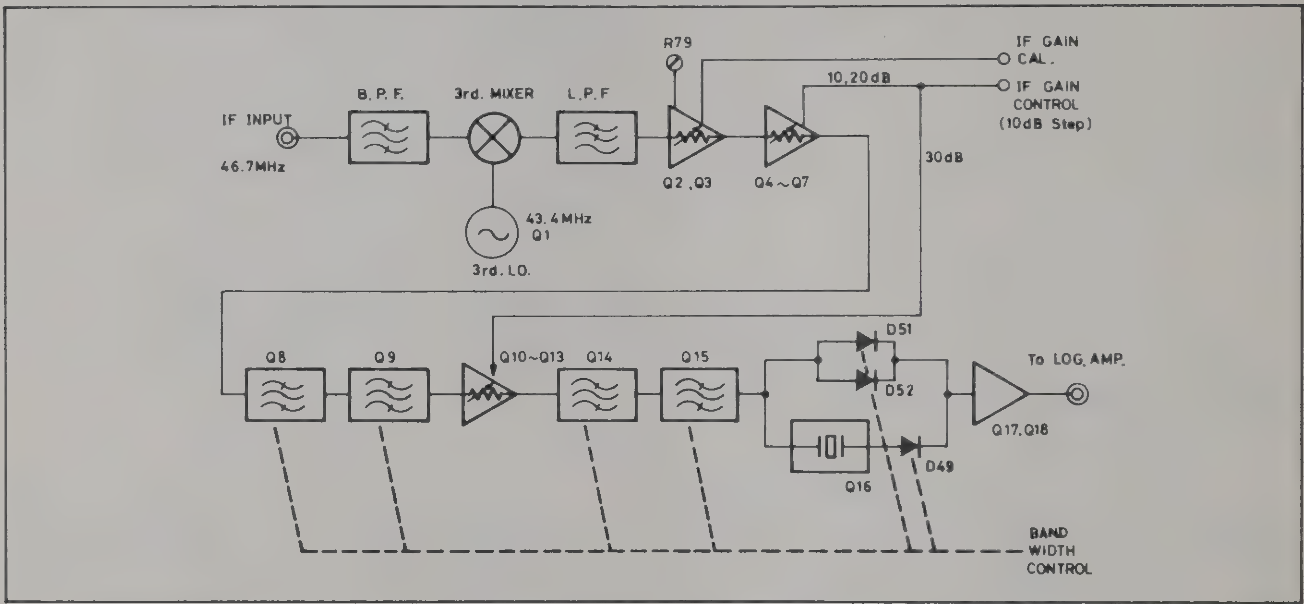

Figure 2.4 IF FILTER Section

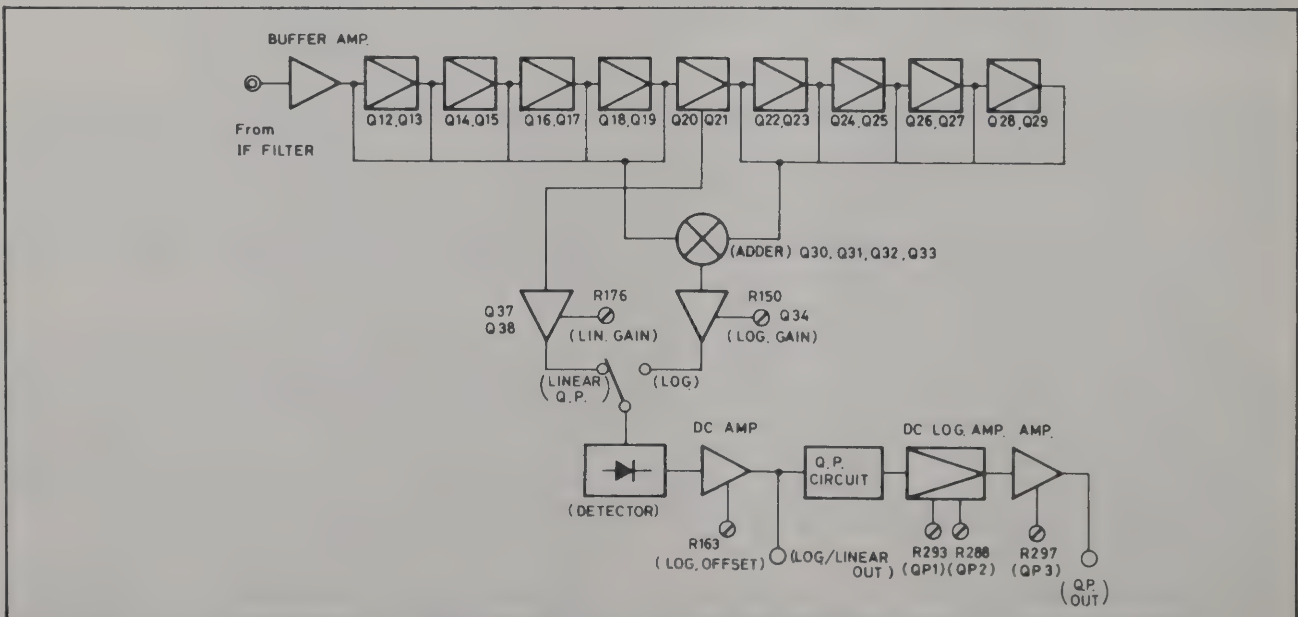

Figure 2.5 LOG. AMPLIFIER Section

TABLE 2.1

C.I.S.P.R./ESA-1000 Specifications

Frequency Range	0.15 MHz to 30 MHz	25 MHz to 300 MHz	300 MHz to 1000 MHz
6 dB Bandwidth	9 kHz	120 kHz	120 kHz
Detection Time Constant Charge Discharge	 1ms±20% 160ms±20%	 1ms±20% 550ms±20%	 1ms±20% 550ms±20%
ESA-1000 specifications			
Frequency Range	100 kHz to 30 MHz	25 MHz to 1000 MHz	
6 dB Bandwidth	9 kHz	120 kHz	
Detection Time Constant Charge Discharge	 1ms±20% 160ms±20%	 1ms±20% 550ms±20%	

the input signal is logarithmically compressed through all nine stages of the saturation amplifiers, added and applied to Q34 the LOG amplifier. Adjustment R150 (LOG GAIN) is adjusted to provide a DC Log Voltage of 500 mV for a 10 dB change in input signal level.

The detector circuit is applied via a filter network to a DC Amplifier whose output also goes through a filter network to the LOG/LINEAR output. If the DETECTION MODE switch is set to the Q.P. position, the LOG/LINEAR output is applied to a Q.P. detector circuit composed of two operational amplifiers. This circuit provides the time constants needed to meet CISPR specifications. A DC log amplifier, comprising an operational amplifier and a dual transistor Q39, logarithmically converts the Q.P. detector output. It is then applied to the Q.P. OUTPUT via an output amplifier.

2.3.7 RAMP GENERATOR AND YIG DRIVER SECTION

The YIG-tuned oscillator output is utilized by the 1st IF MIXER stage as its variable LO input. The YIG oscillator produces an extremely accurate, stable, and linear output capable of sweeping from 100 kHz to 1000 MHz in 20 milliseconds. The CENTER FREQUENCY LED readout displays the tuned frequency of the instrument by using a A/D converter to convert the tuning control current to a digital representation utilizing the current to frequency linearity of the YIG-tuned oscillator.

The REFERENCE LEVEL LED readout for the CRT reference point can be selected to display either the input terminal voltage levels or input levels in terms of field strength readings when an antenna is being used. The input voltage amplitude level is determined by the RF ATTENUATOR and IF GAIN (outer and inner sections) switch settings. The switch settings are converted to voltager, summed by an adder, and applied to an A/D converter to produce the digital equivalent of the reference level which then displayed on the readout. When field strength reference levels are required, the antenna factor of the antenna being used is automatically added to the input level reading. The voltage which corresponds to the instrument's tuned frequency is derived from the YIG-tuned oscillator's control current. It is logarithmically converted and added to the digital voltage corresponding to the input voltage level.

The ramp generator utilizes an operational amplifier with a capacitor coupled feedback network to form an integrating circuit which produces the ramp waveform. The ramp signal is applied to the CRT Driver circuit and to the front panel DISPERSION/DIV. switch. The DISPERSION/DIV. switch setting attenuates the ramp signal which is then returned to the Ramp Generator and YIG DRIVER board. There it is applied via a buffer to an adder together with the sweep signal to control the sweep width of the YIG oscillator center frequency. The output of the adder is then amplified and used to drive the YIG oscillator coil.

2.3.8 CRT DRIVER SECTION

The ramp voltage supplied by the Ramp Generator and YIG Driver board is amplified by a differential amplifier and applied to the X^+ and X^- terminals of the CRT tube.

The Log Amplifier output is applied to a differential amplifier whose feedback level is controlled by FET switch Q27. The FET switch is connected to the 5 dB/DIV. position of the Vertical Axis Scale Selector switch. The circuit is designed so that in the 5 dB/DIV. position, the gain of the differential is double that for the 10 dB/DIV. and LINEAR positions. In addition, Q28 is also activated by the switch to provide an offset to the Y output level. The signal then goes via the VIDEO FILTER network to a differential amplifier whose outputs drive the Y^+ and Y^- terminals of the CRT

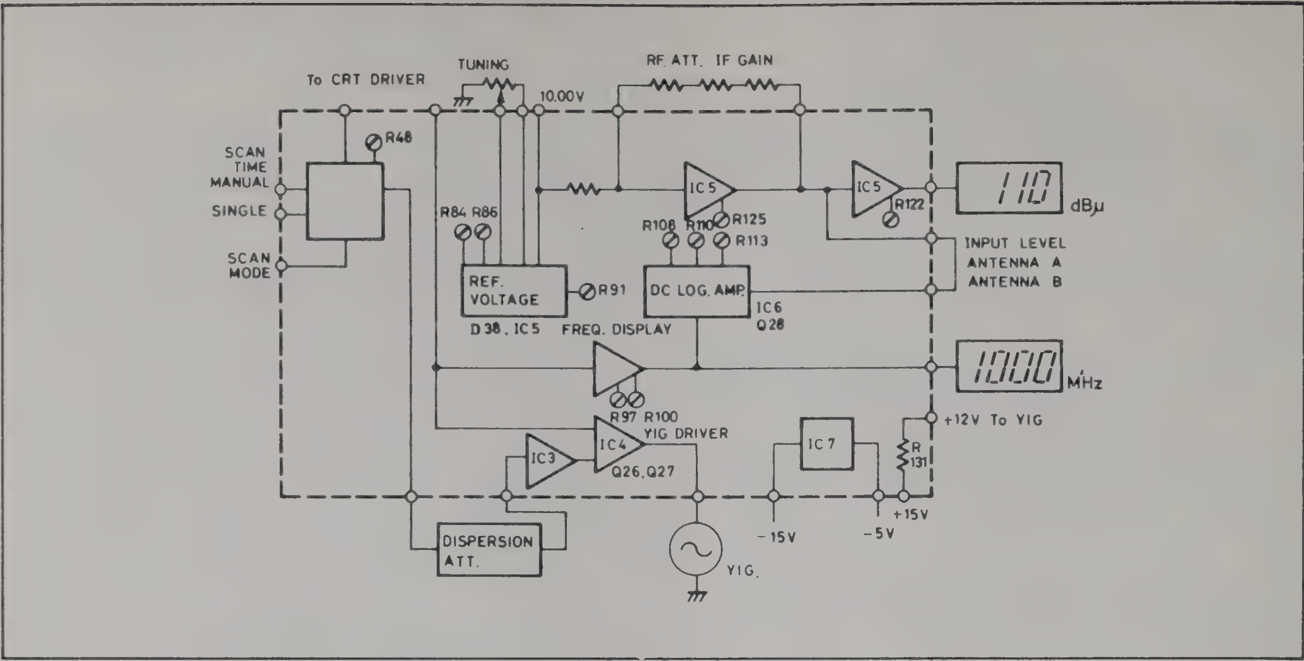

Figure 2.6 RAMP GENERATOR & YIG DRIVER Section

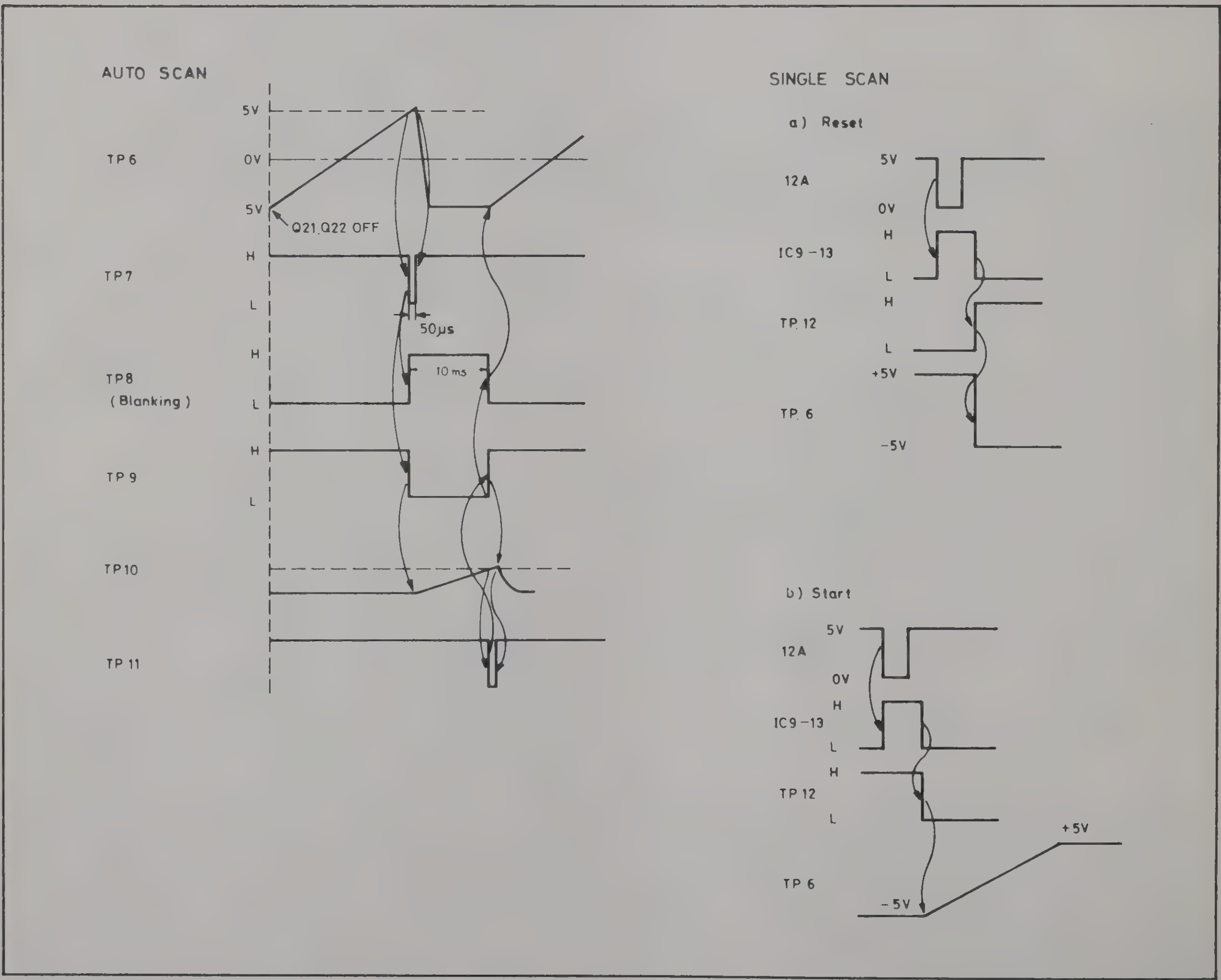

Figure 2.7 Timing Chart in AUTO and SINGLE SCAN Modes

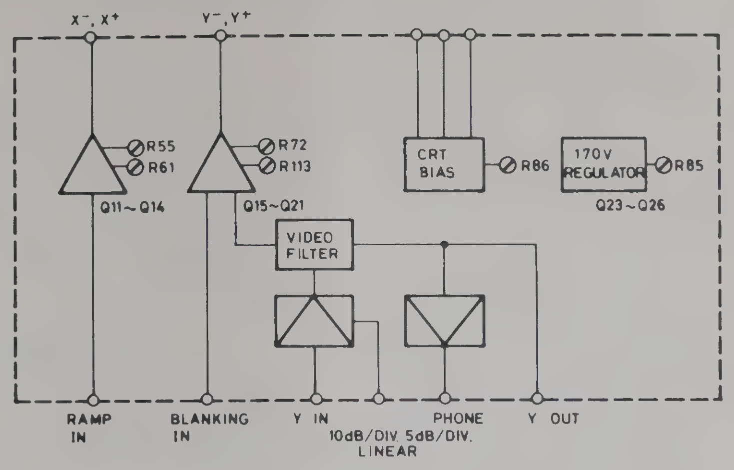

Figure 2.8 CRT DRIVER Section

tube. The same signal is also applied to the Y output for the X-Y recorder and amplified for use by the front panel PHONE jack.

The board also contains a voltage regulator to produce an output voltage of 170 VDC adjusted by R85.

2.3.9 DISPLAY SECTION

Identical LED displays and A/D converter circuits are utilized for the frequency and reference level readouts. When an analog signal at a level of 1.000 V is applied to the A/D converter in addition to the 10.0 VDC reference level from the Ramp Generator and YIG Driver board; the frequency readout will indicate a digital output of 1000, while the reference level readout will indicate a digital output of 100.

2.3.10 CALIBRATION OSCILLATOR SECTION

The Calibration Oscillator utilizes a Colpitts Circuit to produce a frequency of 100 MHz ± 200 kHz at a level of 80 dBuV ± 0.5 dB. The frequency and output level are adjustable by means of L25 and R16 respectively.

2.3.11 HIGH VOLTAGE SECTION

This section provides the high voltage required to drive the CRT tube. The circuit utilizes a 35 kHz oscillator to drive a transformer whose secondary winding voltages are rectified to produce the approximately 2.0 kV voltage levels required.

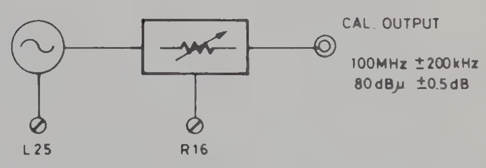

Figure 2.9 CAL. OSC. Section

SECTION III
Operating Instructions

3.1 GENERAL

This section provides information and instructions for the operation of the Spectrum Analyzer Model ESA-1000.

CAUTION

Read all information in this section before attempting operation. Improper operation may cause costly damage to the instrument.

3.2 OPERATIONAL PRECAUTIONS

3.2.1 AC POWER SOURCE. The ESA-1000 operates from an AC power source of 115 VAC ± 10% 50/60 Hz. Operation from an AC power source other than the one specified could cause extensive circuit damage.

3.2.2 POWER MODE SWITCH. This rear panel switch must be set to the AC position for successful operation from the AC power source.

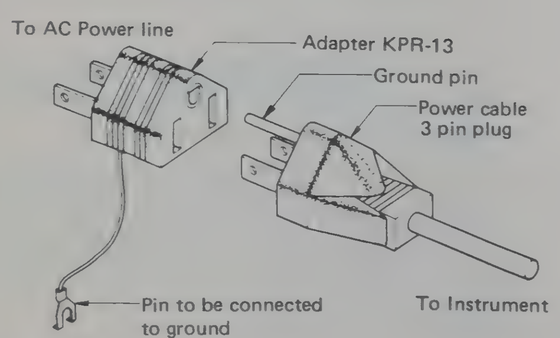

Figure 3.1 Power Cord Plug and Adapter

3.2.3 AC POWER CORD. The front panel AC power switch should always be in the OFF position whenever connecting the AC power cord to the AC power source. This procedure is done to avoid possible damage to the CRT, YIG oscillators, and other critical circuits in the instrument.

3.2.4 GROUNDING. For optimum performance and safety the third prong of the AC power cord must be grounded. When operating from ungrounded power sources, secondary grounding is mandatory. To accomplish this either utilize an adapter plug (See Figure 3.1) or connect a ground wire from the rear panel ground terminal to the nearest available ground source.

3.2.5 The instrument utilizes conduction cooling to remove heat from the higher power circuits within the unit. Therefore it is advisable to keep the rear of the unit free of all obstructions and not to operate the instrument while it is standing on its side.

3.3 CONTROL AND CONNECTOR FUNCTIONS

3.3.1 FRONT PANEL (See Figure 3.2)

NOTE: The circled number corresponds to the same number on Figures 3.2 and 3.3.

1 AC POWER Switch: A maintained action pushbutton switch which places the instrument in operation when an AC power source is utilized.

2 INTENSITY Control: Controls the brightness of the trace on the CRT DISPLAY.

3 FOCUS Control: Controls the sharpness of the trace on the CRT DISPLAY.

4 TRACE ALIGN Adjustment: This screwdriver adjustment is used to align the trace on the CRT DISPLAY.

5 SCAN MODE Selector: Three position toggle switch that selects the scan mode of the instrument; AUTO, MANUAL, or SINGLE.

  a. AUTO: In this position, the sweep is continuously repeated, with the repetition time controlled by the SCAN TIME control.

b. MANUAL: In this position, the SCAN TIME control is used to manually sweep across the CRT DISPLAY.

c. SINGLE: In this position, only one sweep cycle is initiated whenever the START/RESET switch is pushed, with the sweep time controlled by the SCAN TIME control. At the end of the sweep, a bright spot will remain at the right side of the CRT DISPLAY. When this occurs, the START/RESET switch is pushed which resets the sweep and returns the bright spot to the left side of the CRT DISPLAY. This process is repeated each time the single sweep cycle is utilized.

6 SCAN TIME (MANUAL SCAN) Control: Continuously variable control with locking action at extreme CW position. In the SINGLE or AUTO position of the SCAN MODE switch sets the sweep time over a range of 20 msec. to 10 seconds. In the MANUAL position of the SCAN MODE switch, the SCAN TIME control is used to manually sweep across the CRT DISPLAY.

7 START/RESET Switch: When the SCAN MODE switch is set to SINGLE, this push-button switch starts and resets the sweep cycle.

8 CAL OUT Connector: BNC connector for the internal calibration standard. The CAL output signal is 100 MHz at an amplitude level of 80 dBuV and an output impedance of 50 ohms.

9 INPUT Connector: Nominal 50 ohms type N input connector to which the input signal is applied. Input levels should not exceed 130 dBuV or ±50 VDC.

10 RF ATTENUATOR Switch: Adds attenuation to the RF circuits in 10 dB steps, for a total of 40 dB (inner black markings). The outer red markings correspond to an input level which produces a non-distorted level of -70dB for the second harmonic.

11 IF GAIN Switch: A dual control switch. The outer switch adds attenuation to the IF stage in 10 dB steps over a 30 dB range. The inner switch adds or subtracts attenuation in 1.0 dB steps to the IF stage over the range of -6.0 dB to +6.0 dB.

12 CAL Adjustment: Variable adjustment which calibrates the CRT display level whenever the inner switch of the IF GAIN switch is set to CAL.

13 Vertical Axis Scale Selector: Three position slide switch which selects the scale reference for the CRT DISPLAY; LINEAR or LOG 10 dB/5 dB per division.

a. LINEAR: In this position, the CRT DISPLAY becomes a linear presentation. The gain level is automatically raised 40 dB and the value displayed on the REFERENCE LEVEL readout is the amplitude level assigned to the top horizontal line of the scale. The bottom horizontal line of the scale is always assigned the value of OV.

b. 10 dB/DIV. LOG: In this position, the CRT DISPLAY becomes a logarithmic presentation with each horizontal scale line representing 10 dB.

c. 5 dB/DIV. LOG: In this position, the CRT DISPLAY is a logarithmic presentation with each horizontal scale line representing 5 dB.

14 REFERENCE LEVEL Readout: An LED display which indicates the amplitude level for the top horizontal line of the CRT DISPLAY to a 1.0 dB resolution.

15 REFERENCE LEVEL Switch: A three position slide switch which selects whether the REFERENCE LEVEL readout indication is in terms of dBuV or dBuV/M. The three positions are INPUT LEVEL, ANTENNA A (DIPOLE), and ANTENNA B.

a. INPUT LEVEL: In this position, the reference reading is in terms of dBuV for normal inputs to the INPUT connector. NOT BICON

b. ANTENNA A (DIPOLE): In this position, the reference reading is in terms of dBuV/M. In addition the respective antenna factor offset for a half-wave dipole is automatically added to the reading.

c. ANTENNA B: In this position, again the reference reading is in terms of dBuV/M with the respective antenna factor offset for a log periodic antenna is added to the reading.

16 DETECTION MODE Switch: A four position toggle switch divided between two detection modes — MEAN (AVERAGE) and Q.P. (Quasi-Peak) plus sub-selected for the MEAN MODE — three ranges of the VIDEO FILTER; OFF, 10 kHz, or 100 Hz.

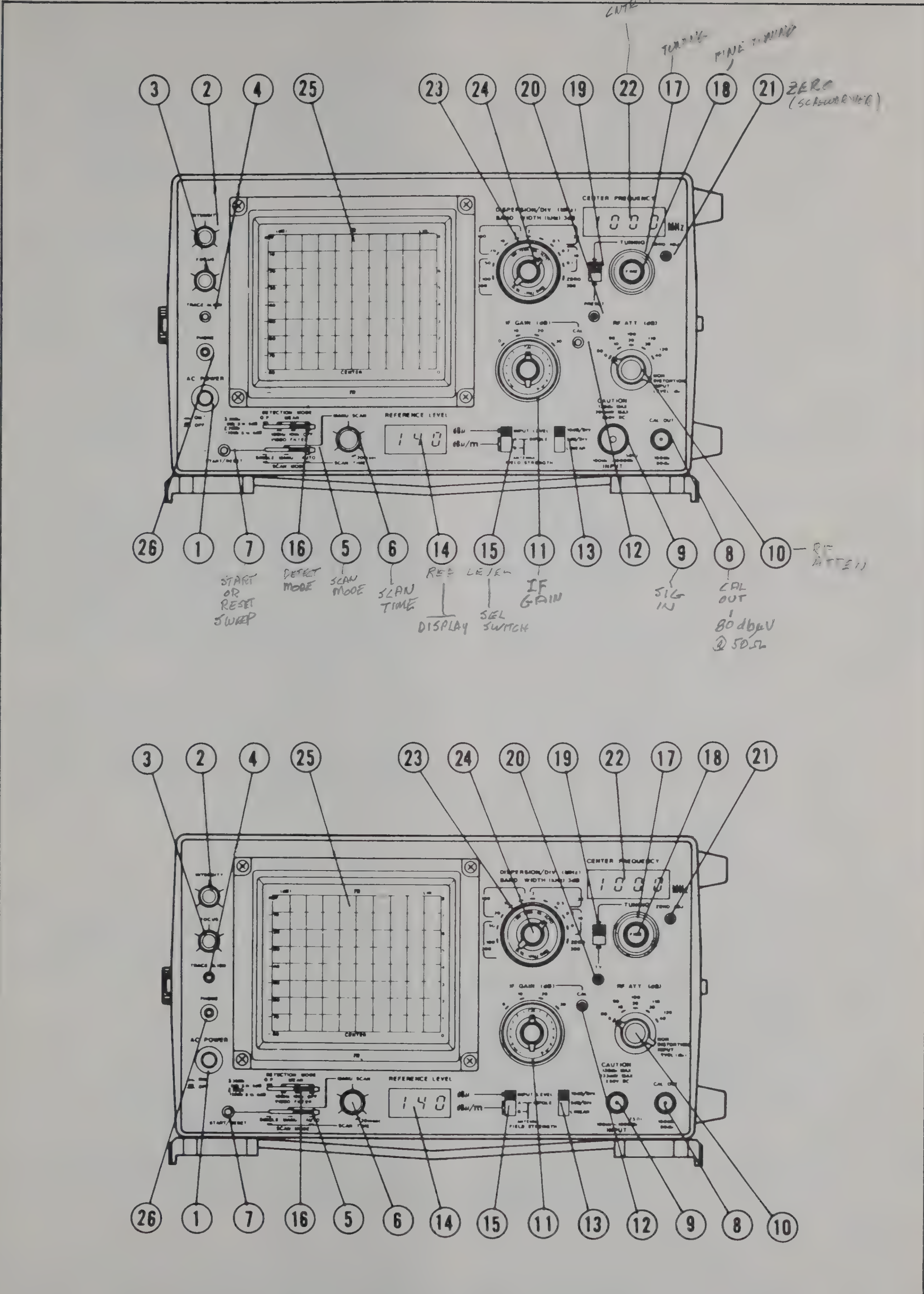

Figure 3.2 Front Panel Controls and Connectors

a. MEAN: In this switch position, average detection of an input signal is accomplished by a fast response detection circuit.

   1. VIDEO FILTER: Switchable only in the MEAN MODE between OFF (NO FILTER), 10 kHz, or 100 Hz. The VIDEO FILTER reduces the noise level on the CRT DISPLAY for improved viewing of the detected signal envelope.

b. Q.P.: In this switch position, input signal detection is accomplished by a Q.P. detection circuit whose time constants (charge and discharge) are CISPR mandated. In addition the gain level is automatically increased 40 dB over that in the MEAN mode. Since the response time of the Q.P. mode is relatively slow, measurements should be taken at the slower sweep speeds or by utilizing the manual scan.

17 TUNING Control: Varies the center frequency of the CRT DISPLAY.

18 FINE TUNING Control: Utilized for fine adjustments of the center frequency; control range ±5.0 MHz minimum.

19 TUNING/PRESET Switch: A two position slide switch which selects between a fixed or variable center frequency.

   a. TUNING: In this switch position, the center frequency of the CRT DISPLAY is controlled by the TUNING control.

   b. PRESET: In this switch position, the center frequency is preset by a variable adjustment to the center frequency desired.

20 PRESET Adjustment: A screwdriver adjustment which sets the center frequency of the CRT DISPLAY when the TUNING/PRESET switch is set to the PRESET position.

21 ZERO Adjustment: A screwdriver adjustment which is utilized to zero calibrate the TUNING control to the CRT indication.

22 CENTER FREQUENCY Readout: An LED digital display which indicates, to a 1.0 MHz resolution, the center frequency of the CRT DISPLAY.

23 DISPERSION/DIV. Switch: A multi-position dual switch, whose outer section selects the horizontal axis for the CRT DISPLAY over a range of 100 MHz/DIV. to 0.1 MHz/DIV. When the inner BANDWIDTH switch is set to the AUTO position, the 3 dB bandwidth is automatically set in conjunction with the DISPERSION/DIV. switch settings as per Table 3.1 When the DISPERSION/DIV. switch is set to the ZERO position, the instrument operates as a tuned receiver at the frequency set by the TUNING control. In this capacity it can be used to demodulate, observe modulated signals, or to monitor single signals.

TABLE 3.1 Automatic Bandwidth Determination

DISPERSION/DIV.	3 dB bandwidth
100 MHz, 50 MHz	300 kHz
200 MHz to 5 MHz	100 kHz
2 MHz to 0.5 MHz	30 kHz
0.2 MHz, 0.1 MHz	10 kHz
ZERO	300 kHz

24 BANDWIDTH Switch: Inner section of the DISPERSION/DIV. switch which selects the IF bandwidth of the instrument. When set to the AUTO position, the 3 dB bandwidth is selected automatically in conjunction with the DISPERSION/DIV. switch settings. The IF bandwidth is also selectable between three 6 dB bandwidths of 9 kHz, 120 kHz, and 1.5 MHz. The 9 kHz and 120 kHz bandwidths are CISPR mandated and are utilized for making CISPR quasi-peak measurements.

25 CRT DISPLAY: A rectangular cathode ray tube with P31 phosphor comprises the visual display. The graticule markings comprises 8 vertical divisions and 10 horizontal divisions.

26 PHONE Jack: Receptacle for 8-ohm earphones.

3.3.2 REAR PANEL
(See Figure 3.3)

27 AC POWER CORD: Permanently attached cord for connection to AC power source.

28 FUSE Holder: Contains main AC power line fuse - 0.5 slow blow.

CAUTION

Always remove instrument from the AC power source whenever replacing fuse.

29 GND Terminal: Utilized (when needed) to connect the instrument to the nearest available ground plane.

30 POWER MODE Switch: A two position slide switch which selects the instrument's power source (AC or DC).

a. AC: In this switch position, the unit utilizes the nominal AC power source.

b. DC: In this switch position, the unit utilizes the external BAT-1000 Battery Pack.

31 EXTERNAL DC INPUT Connector: The power cable for the external BAT-1000 Battery Pack is connected here for external DC operations.

32 X OUTPUT Connector: BNC connector for the horizontal (X) output. Output level approximately ±5.0 V, at an impedance of 10 K.

33 Y OUTPUT Connector: BNC connector for the vertical (Y) output. Output level approximately 0 to 3.5 V, at an impedance of 10 K.

3.4 OPERATING PROCEDURE

This section covers the initial power turn on and calibration procedures.

3.4.1 GENERAL POWER UP PROCEDURE

3.4.1.1 Before power is applied to the ESA-1000 the following should be checked:

a. The AC power source is 115 VAC ±10%, 50/60 Hz.

b. The rear panel POWER MODE switch is set to the AC position.

c. The front panel AC power switch is set to OFF.

3.4.1.2 Set the ESA-1000 front panel controls as follows:

INTENSITY	center position
FOCUS	center position
SCAN MODE	AUTO
DETECTION MODE	MEAN (VIDEO FILTER-OFF)
SCAN TIME (MANU. SCAN)	20ms
REFERENCE LEVEL	INPUT LEVEL
VERTICAL AXIS SCALE SELECTOR	10 dB/DIV.
IF GAIN (dB)	20 dB, CAL.
RF. ATT. (dB)	10 dB
DISPERSION/DIV.	100 MHz/DIV.
B.W. (Hz) 6 dB	AUTO
TUNING/PRESET	TUNING
CENTER FREQUENCY	000 MHz

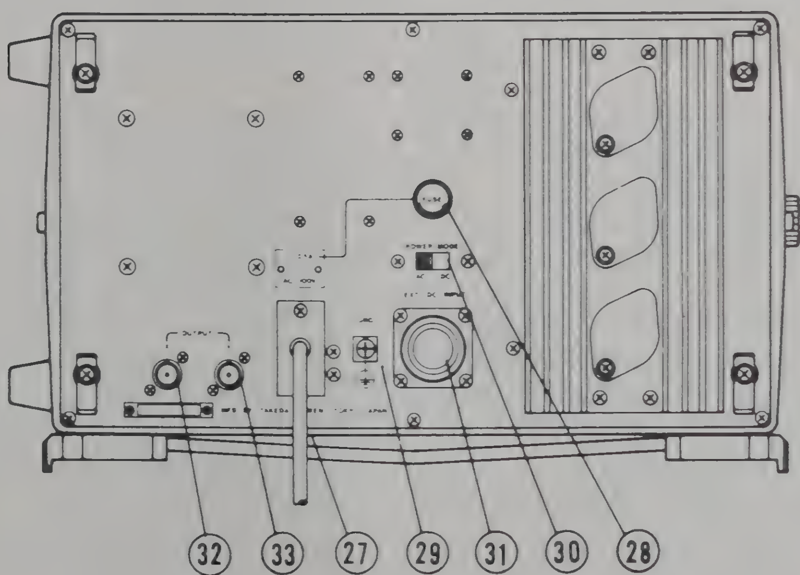

Figure 3.3 Rear Panel Controls and Connectors

3.4.1.3 Connect the AC power cord to the AC power source and energize the instrument by pushing the AC POWER switch to the ON position.

3.4.1.4 A zero frequency trace should appear on the CRT DISPLAY after approximately 20 seconds. If a trace fails to appear, turn the INTENSITY control clockwise until the trace appears. Always adjust the INTENSITY control for optimum brightness according to the viewing conditions encountered.

CAUTION

The CRT may be damaged by excessive intensity for long periods of time.

3.4.1.5 Use the FOCUS control to obtain maximum sharpness of the CRT trace. Always use the FOCUS control in conjunction with the INTENSITY control to obtain a sharp and distinct trace.

3.4.1.6 If the trace is not aligned with the horizontal graticule markings of the CRT DISPLAY, adjust the TRACE ALIGN adjustment to correctly align the trace to the horizontal markings (See Figure 3.4).

3.4.1.7 Before proceeding with this and the following steps, allow a minimum warmup period of 30 minutes. After the warmup period, set the FINE TUNE control to its mechanical center and adjust the TUNING control to position the zero frequency trace at the center of the CRT DISPLAY.

NOTE: The FINE TUNE control is a 3 turn adjustment with a minimum adjustment range of 10 MHz. It is normally utilized whenever the DISPERSION/DIV. switch is set to 0.5 MHz/DIV. or lower for easier tuning control.

Adjust the ZERO ADJUSTMENT to set the CENTER FREQUENCY readout to 000 (if needed).

3.4.1.8 Connect the CAL. OUT output to the INPUT connector. (Use the type N to BNC adapter on the INPUT). The CAL signal spectrum displayed on the CRT will appear as per Figure 3.5.

3.4.1.9 The reference level for the top horizontal line of the CRT graticule, as indicated by the REFERENCE LEVEL readout, is 100 dBuV (es-

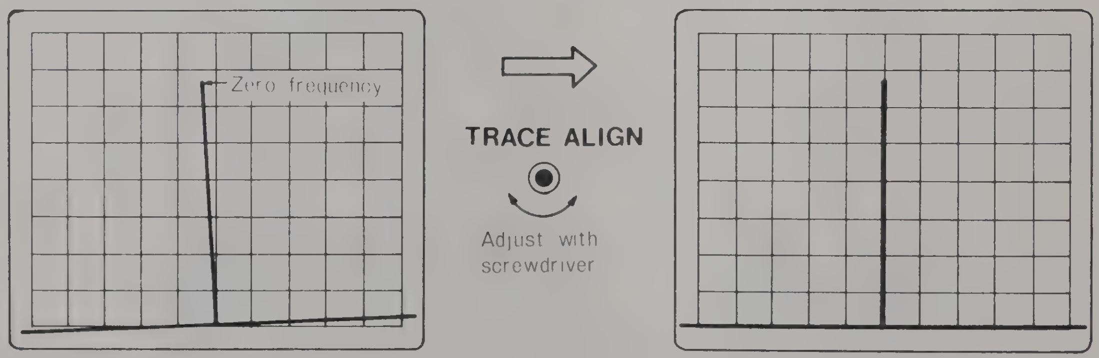

Figure 3.4 Trace Align Adjustment

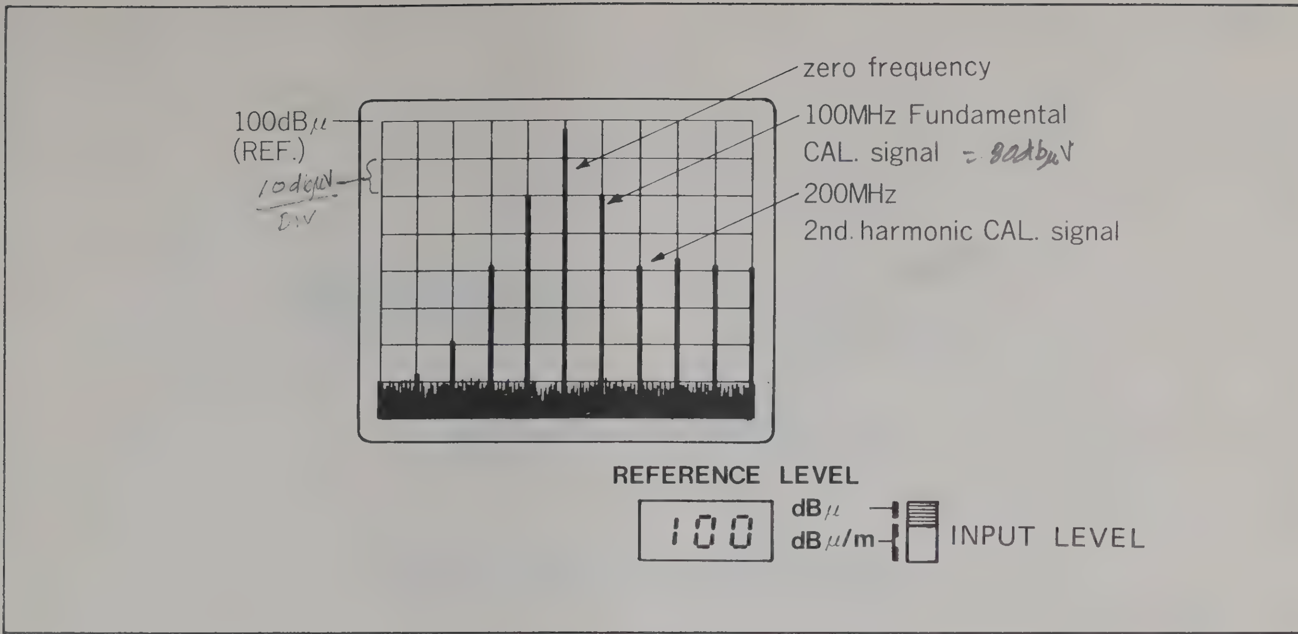

Figure 3.5 CAL. Signal Spectrum display

tablished by initial control settings). The CAL OUT signal is at a frequency of 100 MHz with an amplitude level of 80 dBuV, therefore the signal amplitude level should be 2 divisions or 20 dB down from the reference point (see Figure 3.5). If not, utilize the IF GAIN CAL adjustment (inner switch at CAL) to set the amplitude level to 80 dBuV.

NOTE: In addition to the spectrum display to the right of the zero frequency point, a mirror image will also appear on the left side. Since the levels and frequencies are not accurately displayed, they should not be used for measurement purposes.

3.4.1.10 Rotate the outer section of the IF GAIN switch clockwise (from 20 dB to 30 dB) and note that the signal level on the CRT increases by 10 dB, while the REFERENCE LEVEL readout decreases by 10 dB (100 dBuV to 90 dBuV). (NOTE: The noise level will also increase for this step.) (See Figure 3.6.)

3.4.1.11 Next rotate the switch counterclockwise (from 30 dB to 0 dB); note that the results are the reverse of 3.4.1.10 (e.g. as the IF GAIN decreases, the CRT signal level decreases and the REFERENCE LEVEL increases). (See Figure 3.6.)

3.4.1.12 Rotate the inner section of the IF GAIN switch in a clockwise direction (increasing IF GAIN in 1 dB steps) and again, as per 3.4.1.10, the signal level on the CRT increases in 1 dB steps while the REFERENCE LEVEL readout decreases in 1 dB increments.

3.4.1.13 Rotate the switch in a counterclockwise direction (+6 dB to -6 dB) and note that the results are the reverse of 3.4.1.12 (e.g. the CRT signal level decreases and REFERENCE LEVEL readout increases.)

3.4.1.14 Increase the RF ATTENUATOR switch in a clockwise direction (10 dB to 40 dB) and note that the signal level on the CRT decreases in 10 dB steps, while the REFERENCE LEVEL readout increases in 10 dB increments.

NOTE: Whenever the RF ATTENUATOR switch is set to 0 dB, the amplitude level of the zero frequency trace may vary. This variance of the zero frequency level has effect on the unit's measurement accuracy.

3.4.1.15 To expand a selected signal spectrum, the DISPERSION/DIV. switch is utilized in the following manner:

a. The BANDWIDTH switch is set to AUTO.
b. The TUNING control is utilized to position the signal to be observed at the center of the CRT DISPLAY (see Figure 3.7).
c. The DISPERSION/DIV. switch is turned clockwise to expand the selected signal spectrum. Use the TUNING control to keep the signal position at the center of the CRT DISPLAY.

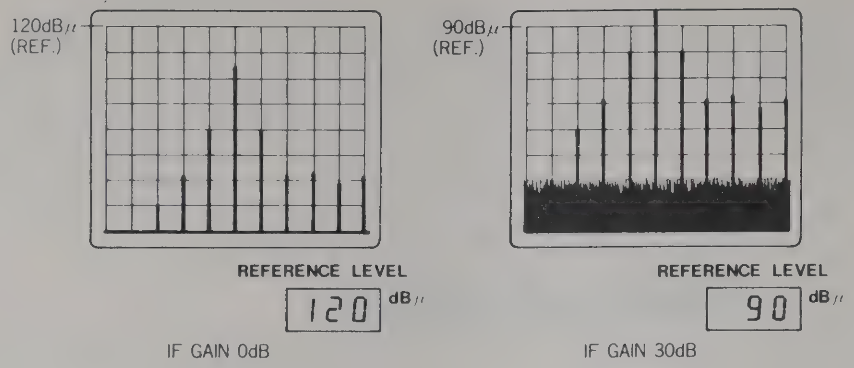

Figure 3.6 Spectrum display by changing IF GAIN

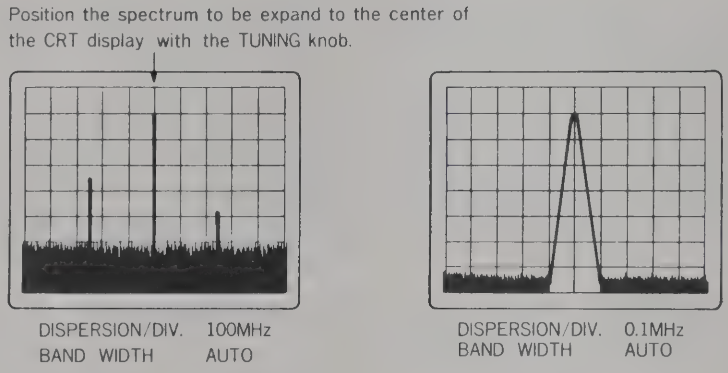

Figure 3.7 Expansion of an Arbitrary Spectrum

3.4.2 DAILY CALIBRATION

Before making signal measurements, it is recommended that the instrument's amplitude level accuracy and CRT DISPLAY accuracy be checked and, if necessary, calibrated on a daily basis.

3.4.2.1 Amplitude Level Calibration.

3.4.2.1.1 Set the ESA-1000 front panel controls as follows:

RF ATT. . . . . 10 dB
IF GAIN . . . . 20 dB, CAL.
TUNING PRESET . . . . TUNING
DISPERSION/DIV. . . . . 50 MHz/DIV.
B.W. (Hz) 6 dB . . . . AUTO
VERTICAL AXIS SCALE
SELECTOR. . . . . 10 dB/DIV.
REFERENCE LEVEL . . . . INPUT LEVEL
SCAN MODE . . . . AUTO
SCAN TIME . . . . 20 ms
DETECTION MODE . . . . MEAN
(VIDEO FILTER-OFF)
CENTER FREQUENCY . . . . 100 MHz

3.4.2.1.2 Connect the CAL OUT signal to the unit's INPUT connector.

3.4.2.1.3 A signal spectrum as per Figure 3.8 should appear on the CRT DISPLAY. The 100 MHz fundamental signal amplitude level should be 2 divisions or 20 dB below the top reference line, if not utilize the IF GAIN CAL adjustment to set the correct amplitude level.

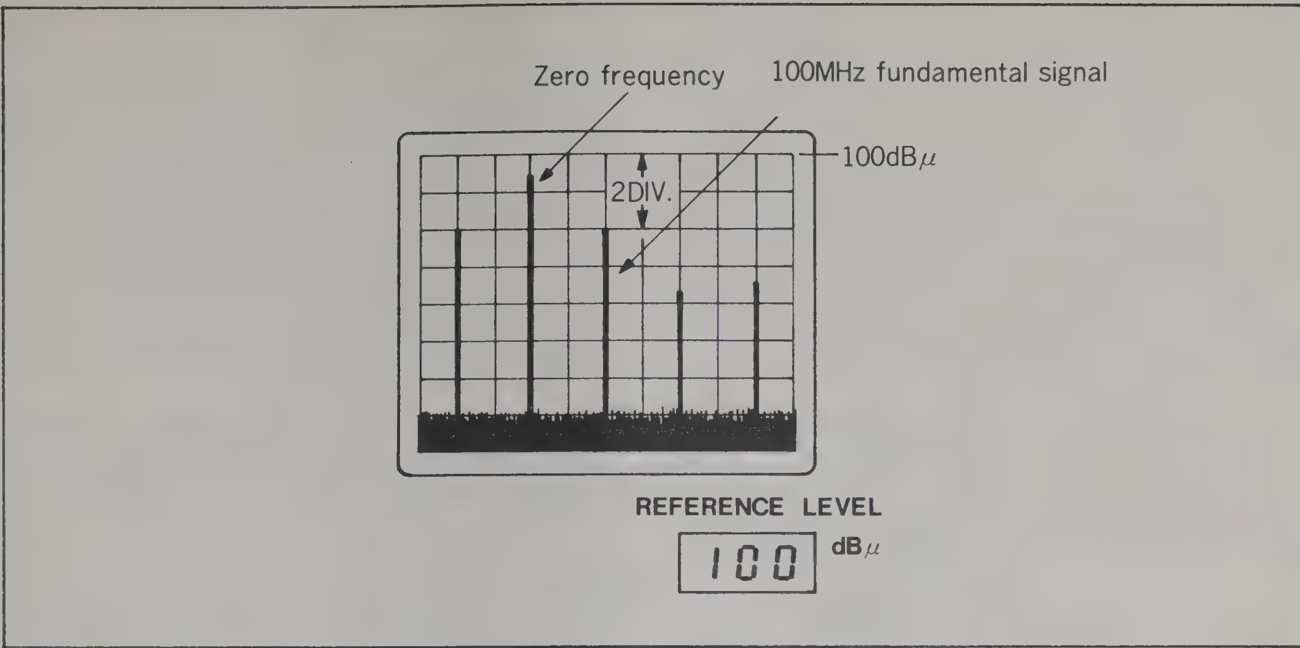

Figure 3.8 dBμ Calibration display

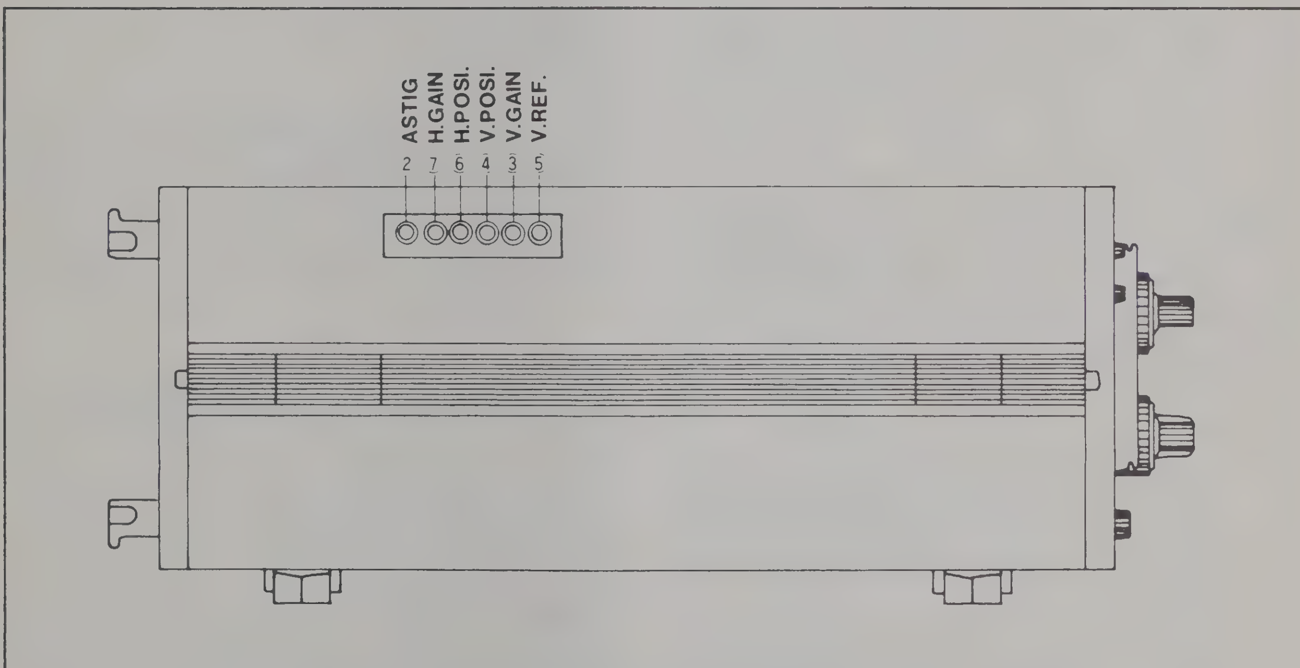

Figure 3.9 CRT Display Calibration

3.4.2.1.4 The CRT DISPLAY is now calibrated in terms of dBuV for amplitude level readings.

3.4.2.2 CRT DISPLAY Calibration.

3.4.2.2.1 A series of screwdriver adjustable calibration controls are located on the left upper side of the unit (see Figure 3.9). These adjustments are utilized for calibration of the CRT DISPLAY functions whenever waveform distortions or amplitude level inaccuracies cannot be corrected by the normal front panel control adjustments.

Whenever such calibration is required, allow a minimum 30 minute warmup period for the instrument to achieve uniform temperature stabilization.

3.4.2.2.2 Set the ESA-1000 front panel controls as per 3.4.2.1.1.

3.4.2.2.3 Trace Alignment Calibration: See 3.4.1.6 and Figure 3.4

3.4.2.2.4 Focus Calibration: If the trace sharpness cannot be adjusted by the front panel FOCUS control; adjust the ASTIG. (ASTIGMATISM) control (see Figure 3.9).

3.4.2.2.5 Vertical-Axis Scale Calibration: If the signal amplitude level on the CRT DISPLAY does not change in 10 dB increments whenever the RF ATTENUATOR, IF GAIN, or input signal is changed by 10 dB; adjust the V. GAIN control (see Figure 3.9).

3.4.2.2.6 Baseline Calibration: Set the outer section of the IF GAIN switch to 0 dB and the 10 dB/DIV., 5 dB/DIV., LINEAR switch to 10 dB/DIV. If the trace has deviated from the baseline, adjust the V. POSI control (see Figure 3.9).

3.4.2.2.7 Vertical-Axis REFERENCE LEVEL Calibration: Switch the Vertical Axis Scale Selector switch between the 10 dB/DIV. and 5 dB/DIV. positions. If the amplitude level of an input signal (CAL signal may be used) shift at the reference point between the two switch positions, adjust the V. REF. control (see Figure 3.9) until no amplitude shift is detected.

3.4.2.2.8 Horizontal-Axis Position Calibration: Utilizing the CAL OUT signal, switch the DISPERSION/DIV. switch from 100 MHz/DIV to 0.1 MHz/DIV. If the signal spectrum at the center of the CRT DISPLAY moves, the H. POSI. (see Figure 3.9) must be adjusted in the following manner:

a. Set the DISPERSION/DIV. switch to the 0.1 MHz/DIV. position. Utilize the TUNING control and center the 100 MHz CAL signal to the center of the CRT DISPLAY.
b. Reset the DISPERSION/DIV. switch to the 100 MHz/DIV. position and adjust the H. POSI. control to center the signal spectrum.

3.4.2.2.9 Horizontal-Axis Scale Calibration: Again utilizing the CAL OUT 100 MHz signal and with the DISPERSION/DIV. switch set to the 100 MHz/DIV. position; the horizontal axis scale of the CRT DISPLAY should be 100 MHz per division. If not, adjust the H. GAIN control (see Figure 3.9) for the correct scale setting.

3.5 BASIC APPLICATIONS

3.5.1 LEVEL MEASUREMENTS

3.5.1.1 When undertaking to make amplitude level measurements of an unknown signal, it is important that the signal's amplitude level does not exceed the instrument's maximum input level. To prevent this from occurring, which will saturate and possibly damage the 1st MIXER stage, always start signal level measurements with the internal RF ATTENUATOR set to its maximum setting (for some measurements, an external attenuator is recommended).

Saturation of the mixer produces a lowered CRT display level due to the phenomenon known as gain compression, whereby an increase in the input signal's amplitude level is displayed on the CRT as being less than the actual increase (e.g. 8 dB for a 10 dB increase). Valid measurements can be made up to the point where the gain compression is 1 dB or less (e.g. 9 dB for a 10 dB increase). For the ESA-1000, gain compression is less than −1 dB for a 100 dBuV input at a 0 dB RF ATTENUATOR setting.

NOTE: Errors may be introduced into amplitude level measurements taken when the RF ATTENUATOR switch is set to the 0 dB position. Therefore it is advisable to refrain from utilizing this switch position especially at higher input levels and frequencies.

3.5.1.2 After tuning in an unknown signal, use the RF ATTENUATOR and IF GAIN switches to adjust the peak level of the input signal to a convenient point on the vertical axis of the CRT graticule. The REFERENCE LEVEL readout will now indicate the absolute level (in dBuV) for the top line of the CRT graticule markings. By arithmetically adding the REFERENCE LEVEL indication and the difference (in dB) of the input signal's peak indication on the CRT from the reference point, the result will be the level of the input signal in dBuV. For example: Assume that the vertical-axis scale is set to 10 dB/DIV. and the signal amplitude level has been set by the RF ATTENUATOR and IF GAIN switches to 2 divisions or 20 dB below the reference point. If the value on the REFERENCE LEVEL readout is 108 dBuV, the level of the input signal will be 108 dBuV + (−20 dB) = 88 dBuV (see Figure 3.10).

3.5.1.3 By keeping the RF ATTENUATION and IF GAIN settings the same and changing the Vertical Axis Scale Selector to 5 dB/DIVISION, the res-

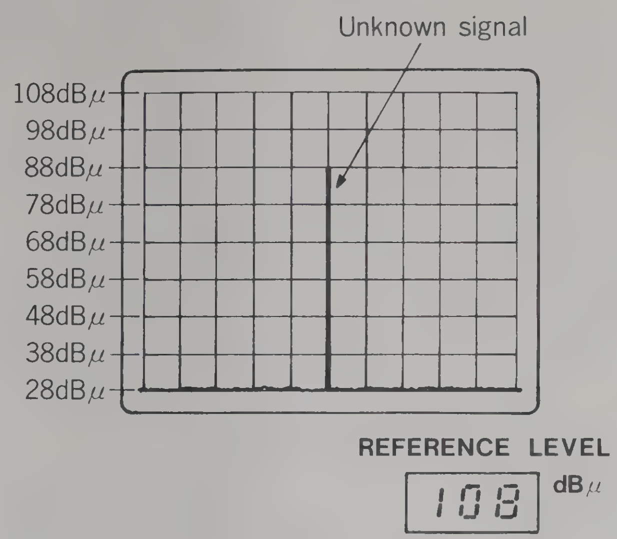

Figure 3.10 Absolute Level Measurement Display

olution of the CRT DISPLAY will be enlarged by a factor of two with the reference point unchanged. Under these conditions, it is recommended that the Amplitude Level calibration procedure of Section 3.4.2.1 be performed prior to taking measurements.

3.5.1.4 In the LINEAR position of the Vertical Axis Scale Selector, the CRT DISPLAY becomes a linear presentation while the internal gain of the unit is increased by 40 dB. Again the REFERENCE LEVEL readout indicates the absolute level of the top scale line (reference point) while the bottom scale line is always equal to 0.0 Volts. Because of the 40 dB gain difference between the LOG and LINEAR scales, whenever utilizing the LINEAR position the RF ATTENUATOR and IF GAIN switches will have to be readjusted to keep the signal trace on the CRT DISPLAY. An example of the relationship between the REFERENCE LEVEL readout indication and the linear sealing on the CRT DISPLAY is given in Table 3.2. As can be seen each 20 dB increase, increases the voltage reading by a factor of 10.

TABLE 3.2

Relation of REFERENCE LEVEL and LINEAR Scale

Reference Level Display	Linear Scale
104 dBμV	20mV/DIV.
98 dBμV	10mV/DIV.
84 dBμV	2mV/DIV.
78 dBμV	1 mV/DIV.
65 dBμV	200 μV/DIV.
58 dBμV	100 μV/DIV.
44 dBμV	20 μV/DIV.
38 dBμV	10 μV/DIV.

3.5.2 FREQUENCY MEASUREMENT

There are three methods by which the frequency of an input signal can be measured with the spectrum analyzer:

a. Absolute Value Method

b. Zero Frequency Method.

c. Reference Signal Method.

Before proceeding with any of the three methods of frequency determination, see Section 3.4 (Operating Procedure) and set the ESA-1000 front panel controls as per Section 3.4.1.2 except for the following: Set the RF ATTENUATOR switch to its 40 dB position.

NOTE: When performing measurements (level, frequency, etc.) of unknown signals, always start with the RF ATTENUATOR

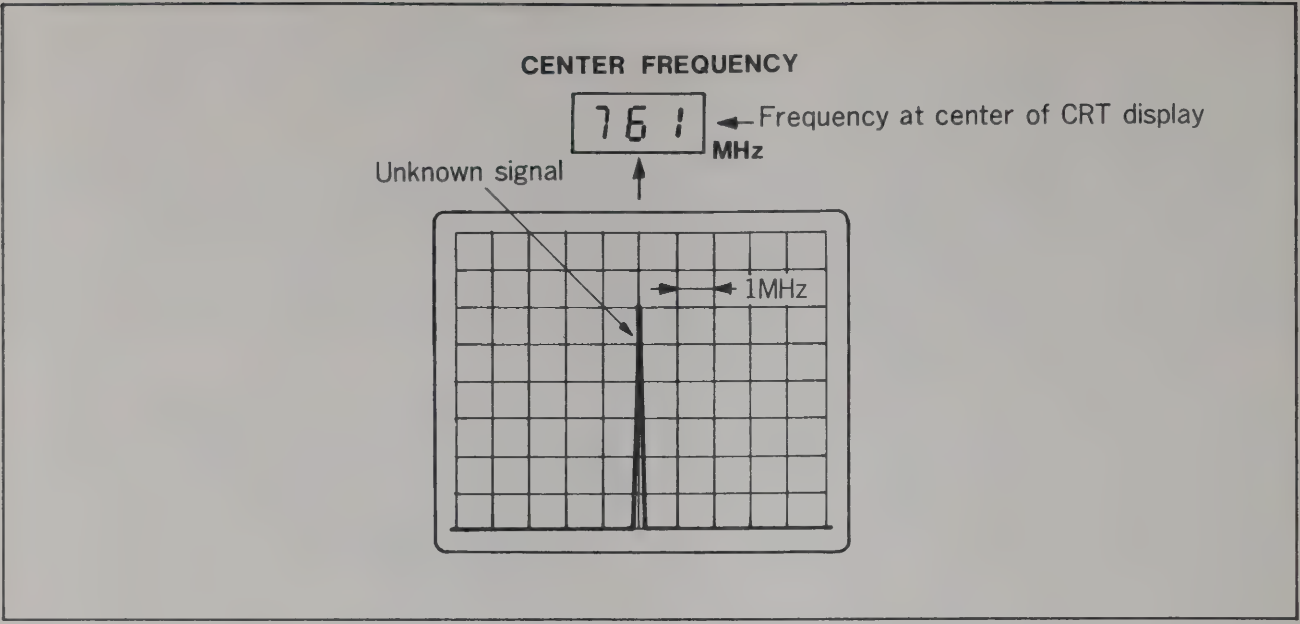

Figure 3.11 Absolute Frequency Measurement Procedure

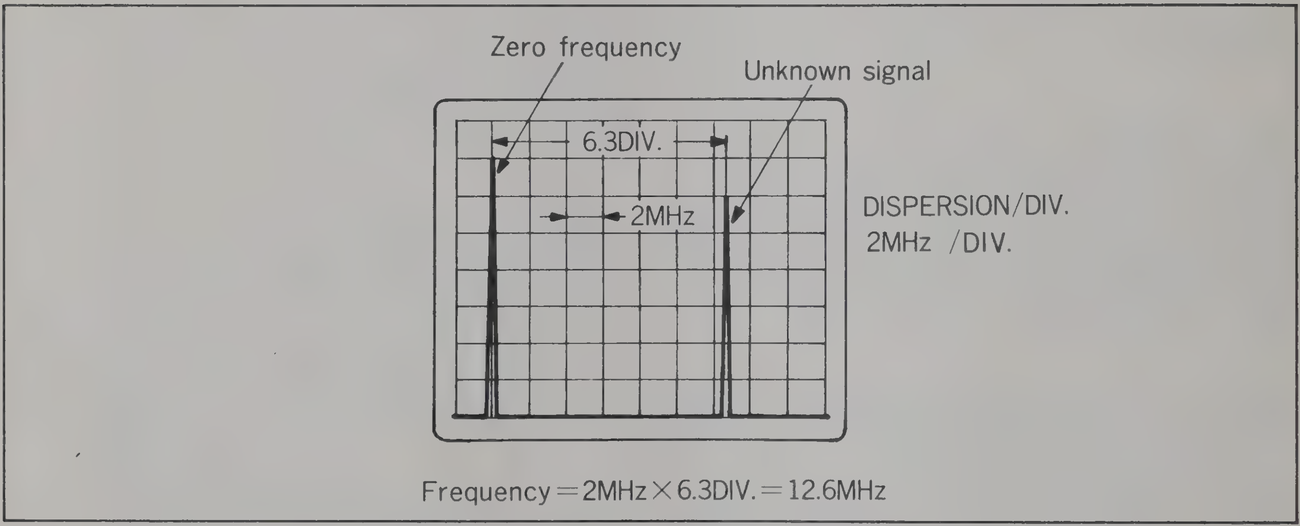

Figure 3.12 Measurement Relative to Zero Frequency

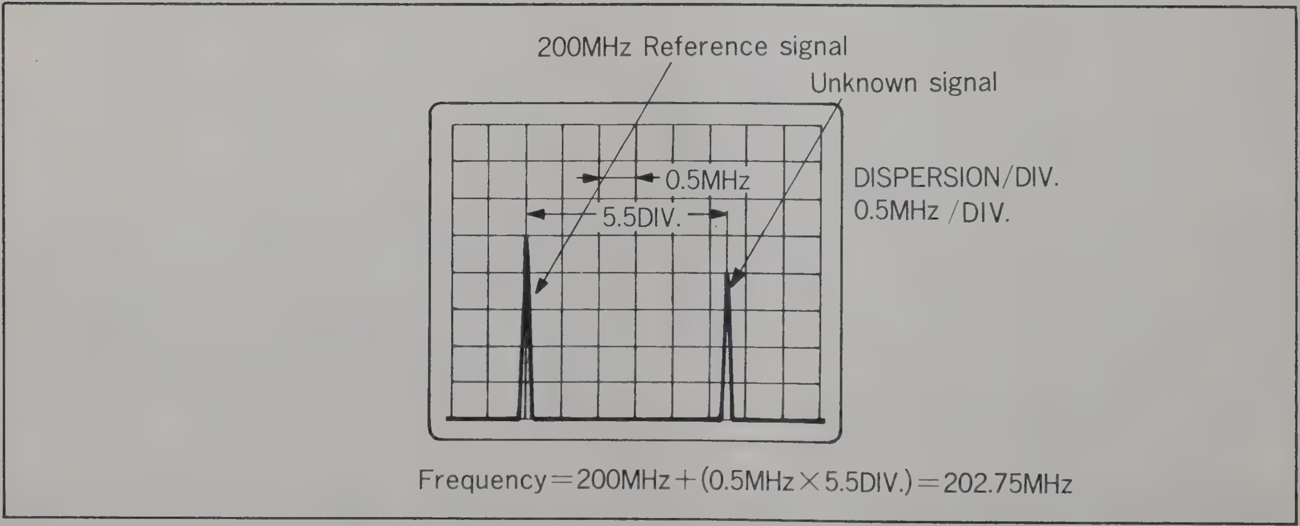

Figure 3.13 Measurement Relative to Reference Signal

switch set for maximum attenuation (40 dB). Use the RF ATTENUATOR and IF GAIN switches in conjunction with each other to set the input signal amplitude level to a convenient point on the CRT DISPLAY.

3.5.2.1 ABSOLUTE VALUE METHOD

3.5.2.1.1 With an unknown signal applied to the unit, set the DISPERSION/DIV. switch to the 1 MHz/DIV. position and use the TUNING control to center the zero frequency trace on the CRT DISPLAY.

3.5.2.1.2 Use a screwdriver to adjust the ZERO ADJUST to set the CENTER FREQUENCY readout to 000.

3.5.2.1.3 Use the TUNING control to position the unknown signal to be measured at the center of the CRT DISPLAY. The frequency of the unknown signal will now be indicated on the CENTER FREQUENCY readout to an error of ±10 MHz (see Figure 3.11).

3.5.2.2 ZERO FREQUENCY METHOD

3.5.2.2.1 With an unknown signal applied to the unit, set the DISPERSION/DIV. switch to a setting which will allow both the zero frequency trace and the input signal to be observed simultaneously on the CRT DISPLAY.

3.5.2.2.2 Note the difference between the two traces on the CRT DISPLAY and find the frequency of the unknown signal by multiplying this value by the setting of the DISPERSION/DIV. switch (see example in Figure 3.12). The error for this method is ±5% of the actual signal frequency.

3.5.2.3 REFERENCE SIGNAL METHOD

3.5.2.3.1 Simultaneously apply the unknown signal and a stable known reference signal to the INPUT of the unit. Set the DISPERSION/DIV. switch to a minimum setting which allows both signal traces to be observed on the CRT DISPLAY.

3.5.2.3.2 Note the difference between the two signals on the CRT DISPLAY and calculate the frequency of the unknown signal by utilizing the following equation (see example in Figure 3.13):

$$fx = fr + (fd \times Ds)$$

where

fx = unknown signal frequency
fr = reference signal frequency
fd = DISPERSION/DIV. setting
Ds = difference between the two signal traces.

NOTE: If the unknown signal is to the right of the reference signal, the difference will have a positive value. If the unknown signal is to the left of the reference signal, the difference will have a negative value.

If an external source is not available for use as a reference signal, the 100 MHz CAL OUT signal contains harmonics which can be conveniently utilized for the reference signals.

TABLE 3.3 Automatic IF Bandwidth Selection

DISPERSION/DIV.	IF Bandwidth (3 dB)	Average Noise Level
100 MHz 50 MHz	300 kHz	20 dBμV
20 MHz 10 MHz 5 MHz	100 kHz	15 dBμV
2 MHz 1 MHz 0.5 MHz	30 kHz	30 dBμV
0.2 MHz 0.1 MHz	10 kHz	5 dBμV
ZERO	300 kHz	20 dBμV

3.5.3 SPECTRUM ANALYSIS

Always perform the Amplitude Level Calibration procedure (Section 3.4.2.1), before proceeding with spectrum analysis of an input signal spectrum.

NOTE: Never utilize the mirror image of the signal spectrum which appears on the left side of the zero frequency trace for measurement purposes since they are not accurately displayed.

3.5.3.1 Apply the unknown signal to the INPUT of the unit, with the DISPERSION/DIV. switch set to the 100 MHz/DIV. position and the RF AT-

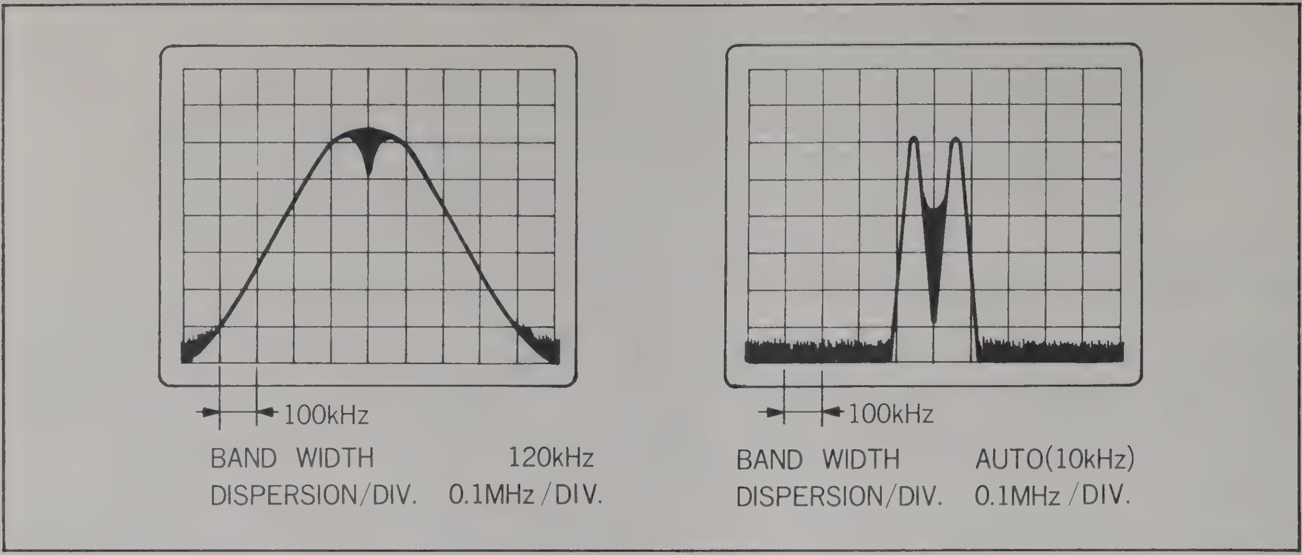

Figure 3.14 Separation of Signals of Same Amplitude

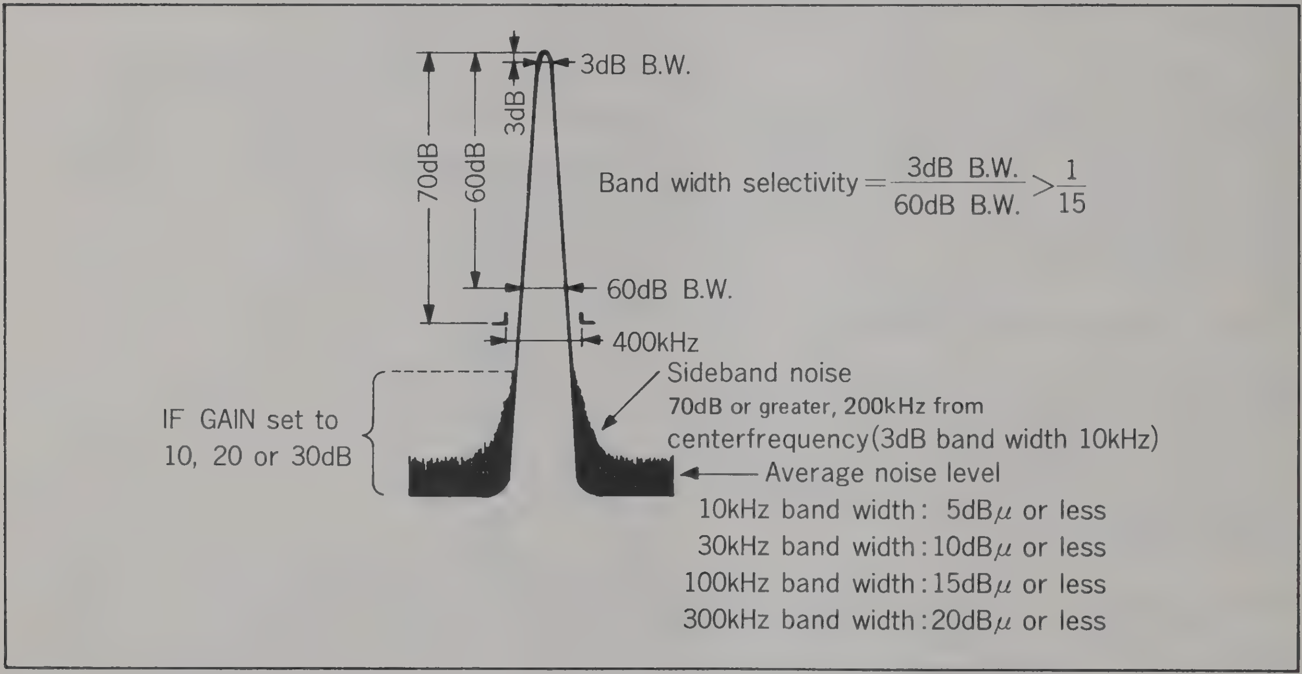

Figure 3.15 Separation of Signals of Different Amplitude

TENUATOR set at the 40 dB position. In combination with the TUNING control, set the RF ATTENUATOR and DISPERSION/DIV. switches so that the signal spectrum remains at the center of and at a convenient level on the CRT DISPLAY.

NOTE: Avoid utilizing the 0 dB position of the RF ATTENUATOR switch due to impedance mismatching, especially at higher input levels and frequencies.

3.5.3.2 For spectrum analysis the BANDWIDTH switch is normally set to the AUTO position, with the 3 dB IF bandwidth being automatically selected in conjunction with the DISPERSION/DIV. switch settings as shown in Table 3.3. The average noise level shown, which depends upon the IF bandwidth, is with the VIDEO FILTER switch set to the 100 Hz position. When measuring a low level signal, set the DISPERSION/DIV. switch to a smaller division setting which in turn will select a narrower IF bandwidth.

3.5.3.3 The BANDWIDTH setting determines the frequency resolution by reason of the IF bandwidth chosen. If the bandwidth is 10 kHz for instance, signal measurements will not be possible unless the difference between two signals is more

than 10 kHz (see Figure 3.14). In addition the time constant becomes longer as the IF bandwidth is made narrower, thus either the scan rate must be set to a slower speed or the DISPERSION/DIV. switch set to a smaller division setting for the same bandwidth. Because of this the instrument is designed to have the optimum 3 dB IF bandwidth automatically selected for the position of the DISPERSION/DIV. switch chosen whenever the BANDWIDTH switch is set to the AUTO position. It also permits, for the conditions stated, measurements to be made at the maximum scan rate of 20 milliseconds for all dispersion/bandwidth conditions. However, when the 6 dB bandwidth is utilized, the bandwidth is not selected automatically for the DISPERSION/DIV. switch position chosen. Thus the level of the signal spectrum may decrease as the IF bandwidth is made narrower and the dispersion per division made wider. In this instance, the scan time must be selected for the optimum signal level.

In addition to its bandwidth, the selectivity of an IF filter also determines what the frequency resolution will be. The selectivity of an IF filter is specified as the ratio of the 60 dB bandwidth to the 3 dB/6 dB bandwidth. The bandwidth selectivity of the ESA-1000 is 15 to 1, thus a frequency difference equal to 7.5 times the 60 dB IF bandwidth or greater is necessary to completely separate two signals with an amplitude difference of 60 dB. In conclusion, good selectivity indicates excellent ability to discriminate between signals of different amplitude levels (see Figure 3.15).

3.5.3.4 In addition to IF bandwidth selectivity, sideband noise also affects the unit's ability to separate signals of different amplitude levels and adjacent frequencies. Sideband noise is the noise which appears on the skirts of an IF filter as shown in Figure 3.15 and influences the unit's frequency resolution when observing signals of different amplitude levels. The sideband noise of the ESA-1000 is specified as being 70 dB or more below the peak of a carrier signal at 200 kHz away from the center of the carrier for a 3 dB IF bandwidth of 10 kHz.

3.5.3.5 The 100 Hz or 10 kHz VIDEO FILTER, which is utilized in conjunction with the MEAN (AVERAGE) portion of the DETECTION MODE switch, are low pass filters which are inserted into the circuit driving the CRT DISPLAY. The low pass filters average the internal noise of the unit which permits observation of a signal waveform located on or near a IF filter skirt or by cleaning up the bottom portion of a signal waveform increases the degree of resolution. Effective averaging occurs whenever the bandwidth of the loww pass filter being utilized is held to 1/30 or less of the selected IF bandwidth circuit. When activated the amplitude level of the signal spectrum may decrease due to the time constant of the low pass filter. In this case, either set the SCAN MODE switch to the MANUAL position or use the SCAN TIME control to set the sweep speed to a slower rate. This will improve the signal/noise ratio by approximately 10 dB as shown in Figure 3.16.

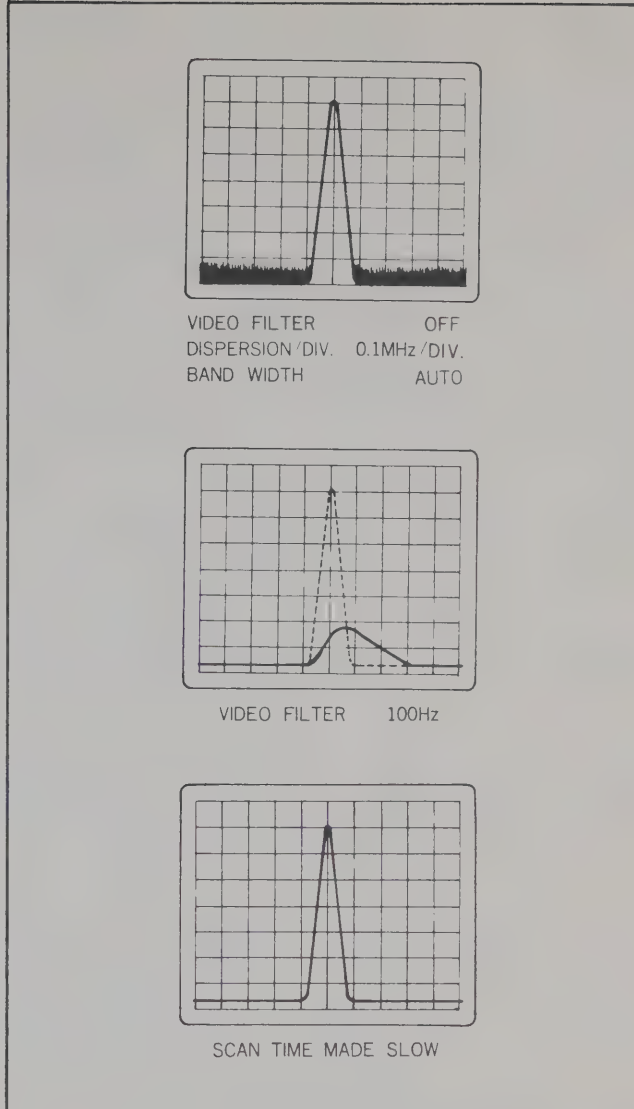

Figure 3.16 Effect of VIDEO FILTER

3.5.4 HARMONIC DISTORTION MEASUREMENT

3.5.4.1 Harmonic distortion is measured in the same manner as the amplitude level measurements described in Section 3.5.1 (Level Measurement)

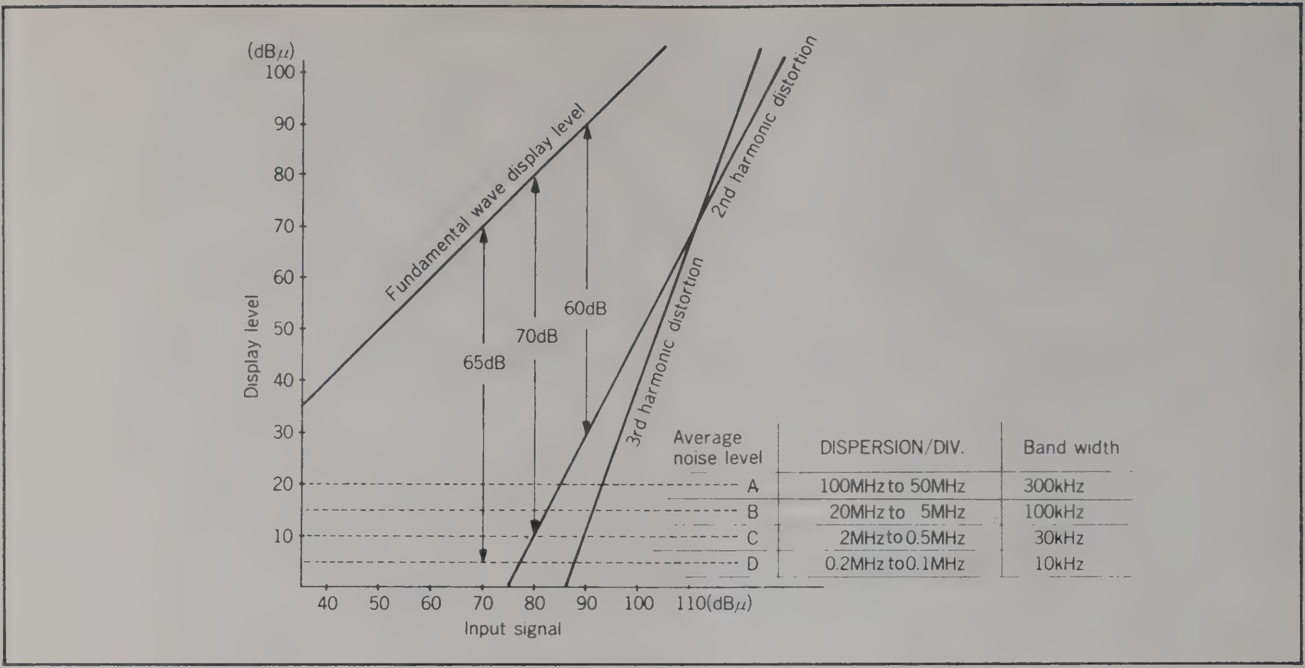

Figure 3.17 Mixer Harmonic Distortion Noise

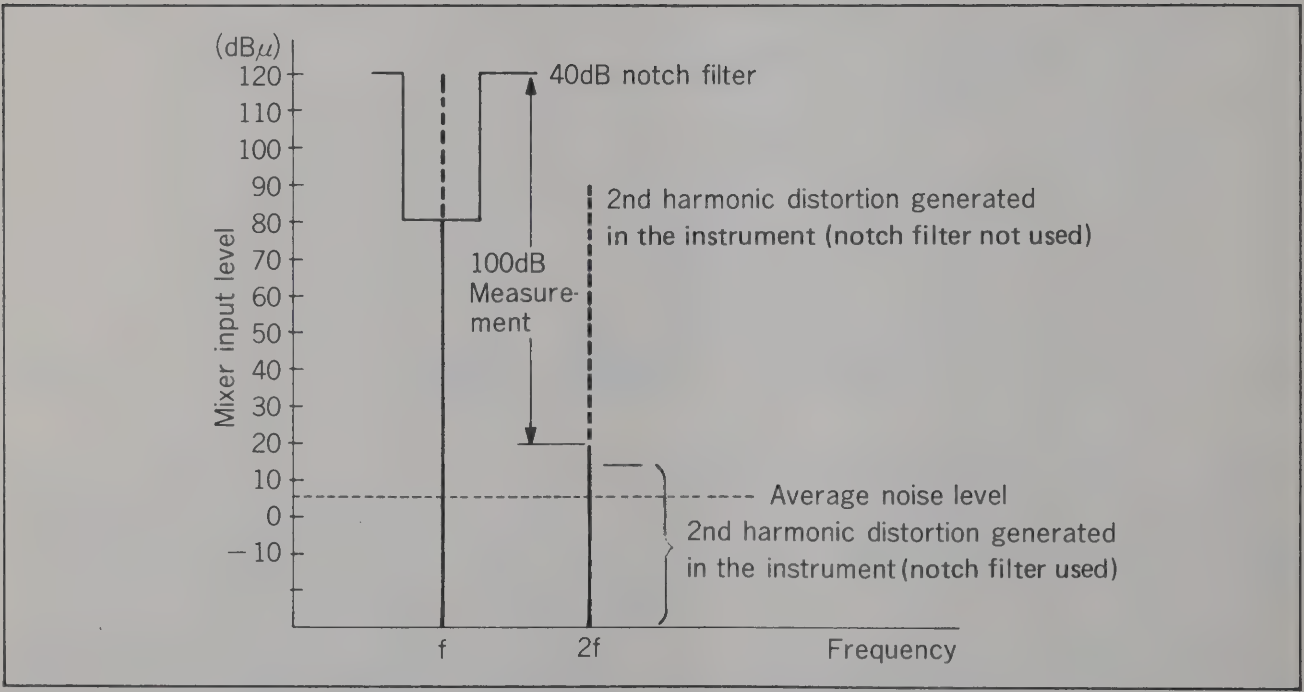

Figure 3.18 Expansion of Dynamic range using a notch filter

and the frequency measurements described in Section 3.5.2 (Frequency Measurement). However in making harmonic distortion measurements, special consideration must be given to the harmonics generated by the 1st MIXER stage of the instrument.

3.5.4.2 Referring to Figure 3.17: if an 80 dBuV level input signal is applied to the unit's 1st MIXER stage, the second harmonic generated by the mixer will be at a level of 10 dBuV or 70 dB down from the fundamental input signal level. If the fundamental input level is increased by 10 dB the second harmonic level will increase by 20 dB. Thus to accurately measure the second harmonic of an input signal which is 60 dB below the input fundamental level, the RF ATTENUATOR (located in before the 1st MIXER stage) must be adjusted to set the input level into the mixer at between 70 and 90 dBuV. As a guide, the input levels at which the instrument will accurately measure a second harmonic level that is 70 dB below the

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fundamental level is indicated as the NON-DISTORTION INPUT LEVEL (dBuV) located above the RF ATTENUATOR control markings on the front panel.

3.5.4.3 When measuring low level distortion signals, the use of a rejection/notch filter for the fundamental signal is recommended. By inserting the filter between the unknown signal and the unit's INPUT, the dynamic range of the unit is increased along with a corresponding increase in the distortion measurement capability (see Figure 3.18). For example, if a fundamental signal at a level of 120 dBuV and with a second harmonic 100 dB down (20 dBuV) is applied via a 40 dB notch filter to the instrument's INPUT the input level of the fundamental is reduced to 80 dBuV. By decreasing the fundamental input level, the level to the 1st MIXER stage is reduced (and thus decreasing the second harmonic outputs generated by the mixer) permitting accurate measurements of second harmonics down 70 dB from the fundamental level. Thus a second harmonic, with a 20 dBuV level, can be accurately measured since the fundamental level is at 80 dBuV instead of 120 dBuV.

3.5.5 FIELD STRENGTH MEASUREMENT

When the REFERENCE LEVEL selector switch is set to either the ANTENNA A or ANTENNA B positions, the CRT DISPLAY reference level (top horizontal line) as indicated by the REFERENCE LEVEL readout will be in terms of dBuV/M. The electric field strength is read directly from the CRT DISPLAY, since the REFERENCE LEVEL display indication includes the appropriate antenna factors for the particular antennas being used. The ANTENNA A position is for a tuned dipole antenna, while the ANTENNA B position is for a log periodic antenna. The antenna factors for the antenna types noted includes losses in the CAL-25 connecting cable (25 FT. RG-55). If another cable type and length is substituted by the operator, its losses will have to be compared with those of the CAL-25 and suitable corrections made to the level readings. — READING + ANT FACTOR + CABLE LOSS + DISTANCE CORR

dbuV db db USUALLY <1db db

NOT

USUALLY 0

= dbuV/M

SEE 3.5.5.5

3.5.5.1 Before proceeding with the field strength measurements, calibrate the instrument for amplitude level and frequency accuracy. Use the amplitude level calibration procedure of Section 3.4.2.1 and the frequency calibration procedure of Section 3.5.2.1.1 through 3.5.2.1.3.

3.5.5.2 Connect the selected antenna to the instrument's INPUT and set the REFERENCE LEVEL selector switch to the ANTENNA A or B position depending on the antenna type used.

3.5.5.3 Use the DISPERSION/DIV. switch to adjust the signal spectrum display for the desired degree of accuracy and signal clarification. The TUNING control is used to center the selected signal at the center of the CRT DISPLAY.

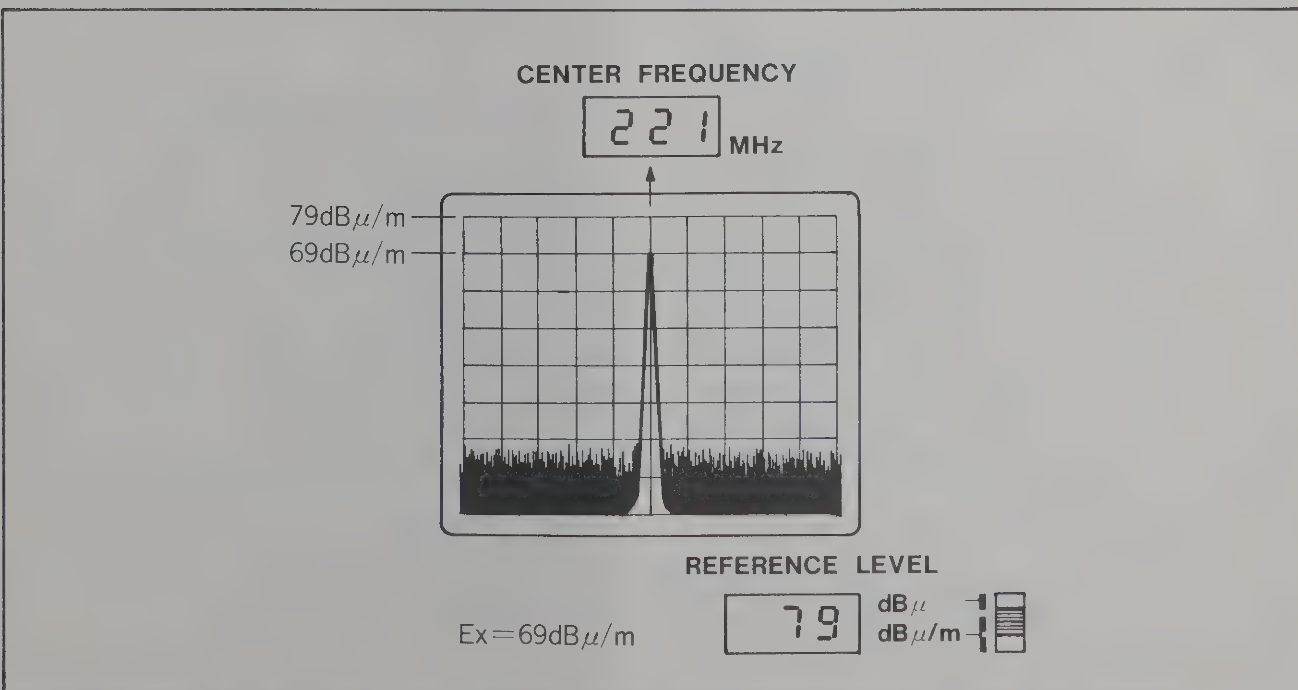


Figure 3.19 Field Strength display

3.5.5.4 The amplitude level of the selected signal is read directly from the CRT DISPLAY in terms of dBuV/M (see Figure 3.19). Since the reference level reading includes the correct antenna (for the antenna utilized) for the selected center frequency, no additional correction factors are normally needed.

3.5.5.5 In those instances where a different type of antenna is utilized, set the REFERENCE LEVEL selector switch to the INPUT LEVEL (dBuV) position. Add the antenna factor for the selected antenna to the amplitude level reading to obtain the correct level in terms of dBuV/M. In addition other correction factors, for example cable losses, may also need to be added to the indicated reading.

3.5.6 Noise Field Strength (Quasi-Peak Value) Measurement utilizing Dipole Antenna.

When the ESA-1000 DETECTION MODE switch is set to the Q.P. position and the 6 dB IF bandwidth switch set to either the 9 kHz or 120 kHz position, the amplitude level measurements will be to CISPR quasi-peak specifications and standards. See Table 3.4 for CISPR time constants, bandwidths, and frequencies.

TABLE 3.4 CISPR Time Constants and Bandwidths

Frequency Range	150 kHz to 30 MHz	25 MHz to 1000 MHz
6 dB Bandwidth	9 kHz	120 kHz
Q.P. Detector Charge Time	1 msec ± 20%	1 msec ± 20%
Q.P. Detector Discharge Time	160 msec ± 20%	550 msec ± 20%

Due to the relatively slow response time of the quasi-peak circuitry, Q.P. measurements should be taken with the SCAN MODE switch set to either the MANUAL position (for manual control of the scan) or for a slow sweep speed in the AUTO position. An alternative to setting the SCAN MODE switch to MANUAL, is to set the DISPERSION/ DIV. switch to the ZERO position and operating the instrument as a tuned receiver. The quasi-peak detection circuit has a dynamic range of 40 dB compared to a dynamic range of 80 dB for the average (mean) detection circuit.

3.5.6.1 Before proceeding with the noise field strenth (Q.P.) measurements, perform the amplitude level calibration procedure of Section 3.4.2.1 and the frequency calibration procedure of Section 3.5.2.1.1 through 3.5.2.1.3.

3.5.6.2. Set the ESA-1000 front panel controls as follows:

RF. ATT. .... 40 dB
IF GAIN .... 0 dB
DISPERSION/DIV. .... 100 MHz/DIV.
B.W. (Hz) 6 dB .... 1.5 MHz (6 dB)
TUNING/PRESET .... TUNING
DETECTION MODE .... MEAN
(VIDEO FILTER-OFF)
SCAN MODE .... AUTO
REFERENCE LEVEL .... ANTENNA-A
VERTICAL AXIS SCALE
SELECTOR. .... 10 dB/DIV.

3.5.6.3 Connect the dipole antenna to the INPUT of the instrument, a broad signal spectrum should appear on the CRT DISPLAY. Adjust the RF ATTENUATOR to set the peak of the spectrum display at a point not to exceed 10 dB (1 division) below the reference point of the CRT graticule (to prevent mixer gain compression).

3.5.6.4 Next adjust the IF GAIN to set the spectrum peak at a point not to exceed the top horizontal reference line of the CRT graticule (to prevent overload of the IF section).

3.5.6.5 Use the TUNING control to center the unknown signal to be measured at the center of the CRT DISPLAY. The CENTER FREQUENCY readout will indicate the frequency of the selected signal.

3.5.6.6 Either set the DISPERSION/DIV. switch to the ZERO position or the SCAN MODE switch to the MANUAl position. In the ZERO position of the DISPERSION/DIV. switch, a single trace representing the selected signal will appear on the CRT DISPLAY. Peak for maximum amplitude using the frequency TUNING control. In the MANUAL position of the SCAN MODE switch, a bright spot will appear on the CRT DISPLAY. Use the MANUAL SCAN control to position the bright spot at the center of the CRT DISPLAY and the frequency TUNING control to peak the bright spot for maximum amplitude level.

As in the field strength measurements, the appropriate antenna factor is automatically added to the REFERENCE LEVEL indication.

3.5.6.7 Reset the ESA-1000 front panel controls as follows:

B.W. (Hz) 6 dB .... 9 kHz or 120 kHz
(Selected according to frequency)
DETECTION MODE .... Q.P.
VERTICAL AXIS SCALE
SELECTOR .... 5 dB/DIV.

NOTE: Whenever the DETECTION MODE switch is set to the Q.P. position, the REFERENCE LEVEL indication will decrease by 40 dB since the gain is automatically increased by 40 dB within the instrument. Because of this, the CRT DISPLAY presentation may disappear under some measurement conditions. Readjust the RF ATTENUATION and IF GAIN to bring the presentation back onto the CRT.

3.5.6.8 The amplitude level displayed on the CRT is the noise field strength of the signal under measurement. The amplitude level is read as follows:

NOISE FIELD STRENGTH (dBuV/M) = REFERENCE LEVEL indication (dBuV/M) + CRT DISPLAY amplitude level different from Reference point (dB).

Therefore: If the REFERENCE LEVEL Indication = 79 dBuV/M, and the amplitude level on the CRT DISPLAY = 4 divisions down from the reference level or 4 DIV. X 5 dB/DIV. = -20 dB

thus the NOISE FIELD STRENGTH = 79 dBuV/M + (-20 dB) = 59 dBuV/M.

Figure 3.20 shows the CRT DISPLAY presentation when the DISPERSION/DIV. switch is set to the ZERO position. As noted above, only a bright spot appears when the SCAN MODE switch is set to the MANUAL position.

3.6 DM-1000 DIGITAL MEMORY OPTION

3.6.1 GENERAL

The DM-1000 Digital Memory accessory is a factory added option which allows the ESA-1000 Spectrum Analyzer to store the CRT spectrum presentation data in digital form. The memory unit contains two data storage channels: Channel A which continuously updates the CRT DISPLAY and Channel A/B which fixes the data in one channel for a static CRT display while the other channel continuously updates the CRT DISPLAY.

The DM-1000 enables the ESA-1000 to make accurate waveform measurements at the slower sweep rates required by certain measurement conditions. The single channel memory mode enables the input information to be acquired at the slower sweep rates, while the CRT display is continuously updated at a faster sweep rate. In addition when performing comparative measurements utilizing reference signals or making field strength measurements especially to CISPR specifications, the dual channel mode will enable accurate and precise measurements to be quickly accomplished.

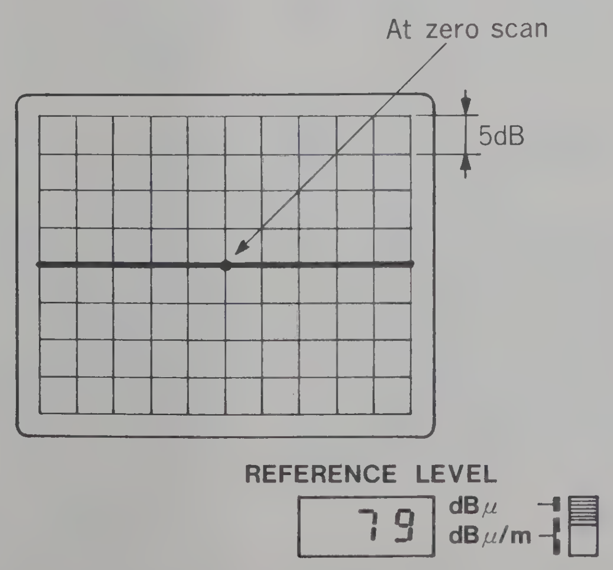


Figure 3.20 Noise Field Strength Measurement Procedure

3.6.2 DM-1000 SPECIFICATIONS

Memory:	X axis 9 bits, 512 points. Y axis 8 bits, 256 points.
Write time:	20 msec. to 10 sec. depending on the ESA-1000 SCAN MODE time setting.
Display time:	Approximately 4 msec., full-scale repetition.
Sampling Error:	Y axis 2.5% max.
Storage function:	Memory contents stored by setting the ESA-1000 SCAN MODE to MANUAL.
Display function:	A — display of data in memory channel A. A/B — display of data in memory channel A and B.
Operating temperature:	0°C to +40°C.
Power requirements:	All power required supplied by ESA-1000.
Power consumption:	Approximately 25 VA.
Warmup time:	Approximately 30 minutes.
Dimensions:	Approximately 11.4" (W) X 1.6" (H) X 15.3" (D) (290X40X390

3.6.3 DM-1000 PANEL CONTROLS (See Figure 3.21)

3.6.3.1 MEMORY ON/OFF Switch: A maintained action pushbutton switch, which activates the DM-1000 memory functions when pushed to the ON position. In the OFF position, the analyzer functions in its normal mode of operation.

3.6.3.2 A and A/B Switch: A maintained action pushbutton switch, which activates the two modes of memory operation. In the A position, the data in channel A is displayed on the CRT display and continuously updated. If the SCAN MODE switch is set to MANUAL, the data in channel A will be fixed as will the CRT DISPLAY. In the B position, the data in channel A will be fixed for the CRT display while the data in channel B will be continuously updated and displayed. Again if the SCAN MODE switch is set to MANUAL, the data in both channels will become fixed.

3.6.3.3 FUSE holder: Contains the input AC power (from ESA-1000) line fuse: 0.20A (slow-blow).

3.6.4 PRELIMINARY PRECAUTIONS

3.6.4.1 Since the ESA-1000 and the DM-1000 are connected internally. It is recommended that the two units not be separated.

3.6.4.2 When the ESA-1000 SCAN MODE switch is set to the SINGLE position, only the normal sweep operation will be performed, the normal sequence of single sweep functioning is performed for making another sweep.

3.6.5 OPERATING PROCEDURE DM-1000

CAUTION

Before turning on the ESA-1000 Spectrum Analyzer, always set the A, A/B selector switch to the A position.

3.6.5.1 Set the DM-1000 front panel controls as follows:

MEMORY ON/OFF switch — OFF
A, A/B switch — A position

3.6.5.2 Place the ESA-1000 AC POWER switch to its ON position.

3.6.5.3 Place the MEMORY ON/OFF switch to the ON position. With the A, A/B switch in the A position, input signal information will be accepted into channel A at the rate set by the ESA-1000, but displayed on the CRT and continuously updated at a 4 msec. rate.

3.6.5.4 If the ESA-1000 SCAN MODE switch is set to MANUAL, no updated data to the input of channel A will be accepted. The memory contents will remain fixed for the last data input before the MANUAL scan mode was activated. The CRT DISPLAY will remain unchanged until the scan sweep mode is altered.

3.6.5.5 To make comparison measurements, switch the A, A/B selector switch to the A/B position. When this occurs, the data in channel A at the time the switching occurs will become fixed as will the CRT display for A. At the same time, input information will be continuously supplied to channel B to keep the CRT display for B updated.

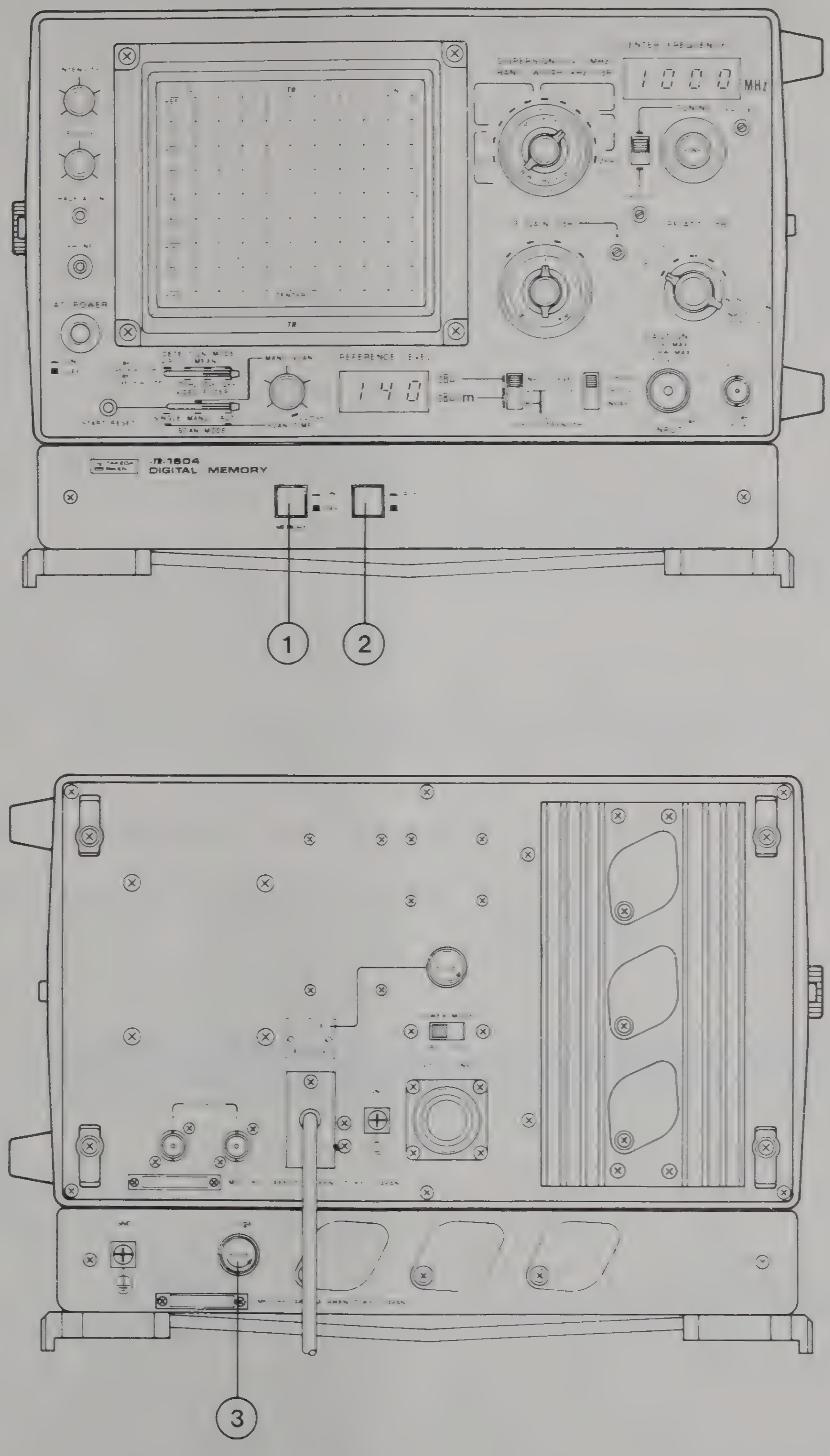


Figure 3.21 DM-1000 Front and Rear Panel

3.6.5.6 If, as in Section 3.6.5.4, the ESA-1000 SCAN MODE switch is set to the MANUAL position without changing the other control positions, the A/B channel data contents will become fixed. The CRT will display the waveforms at the instance the MANUAL mode was activated.

3.6.6 CRT DISPLAY CALIBRATION PROCEDURE (Refer to Figure 3.22)

For the CRT calibration procedure with the DM-1000 Memory unit's MEMORY ON/OFF switch in the OFF position, see Section 3.4.2.2 (CRT DISPLAY Calibration). When the DM-1000 is activated (MEMORY to ON) refer to Section 3.4.2.2 before proceeding with the additional CRT calibration procedure described in the following section.

NOTE: For the following procedure, utilize either the 100 MHz, 80 dBuV level CAL signal of the unit or an equivalent input from a signal reference source.

3.6.6.1 Vertical scale calibration: If the signal amplitude level on the CRT DISPLAY does not vary by 10 dB whenever the ESA-1000 RF ATTENUATOR, IF GAIN, or input signal level is changed by 10 dB, adjust the Y GAIN control.

3.6.6.2 Base line calibration: (NO input signal required) Set the ESA-1000 IF GAIN switch to the 0 dB position and set the vertical axis select switch (10 dB/DIV., 5 dB/DIV., LINEAR) to the 10 dB/DIV. If the base line trace is not on the horizontal bottom graticule line, adjust the Y POSI control to position the trace.

3.6.6.3 Horizontal axis position calibration: Apply a 100 MHz input signal and set the ESA-1000 DISPERSION/DIV. switch to the 100 MHz/DIV. position and the DM-1000 MEMORY ON/OFF switch to the OFF position. Position the signal display to the center of the CRT and switch the MEMORY ON/OFF switch to the ON position. If the signal display shifts from the center position, adjust the X POSI control until no signal shift is detected.

3.6.6.4 Horizontal scale calibration: Use the 100 MHz CAL OUT signal of the ESA-1000 and the resultant harmonics for this procedure. Set the ESA-1000 DISPERSION/DIV. switch to the 100 MHz/DIV. position and calibrate the horizontal scale of the CRT to 100 MHz per division using the X GAIN control.

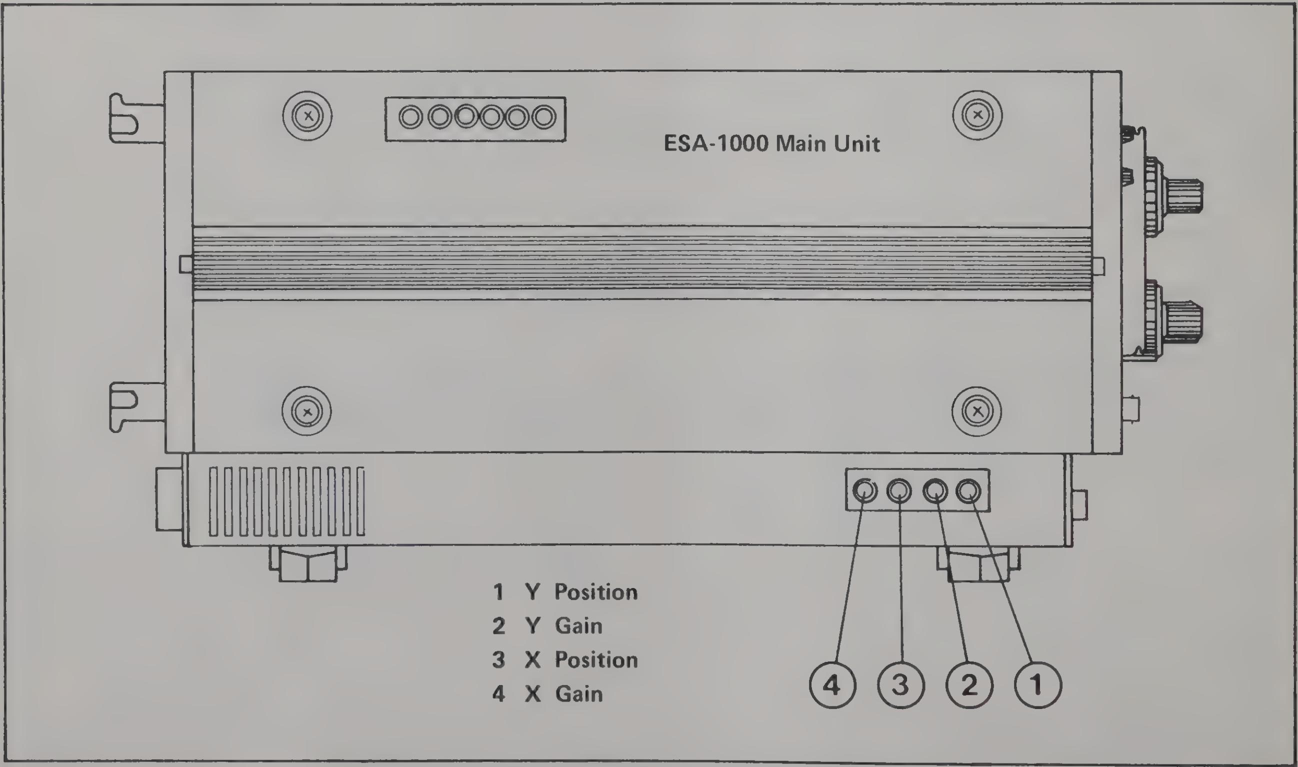


Figure 3.22 CRT Display CAL Adjustments (DM-1000)

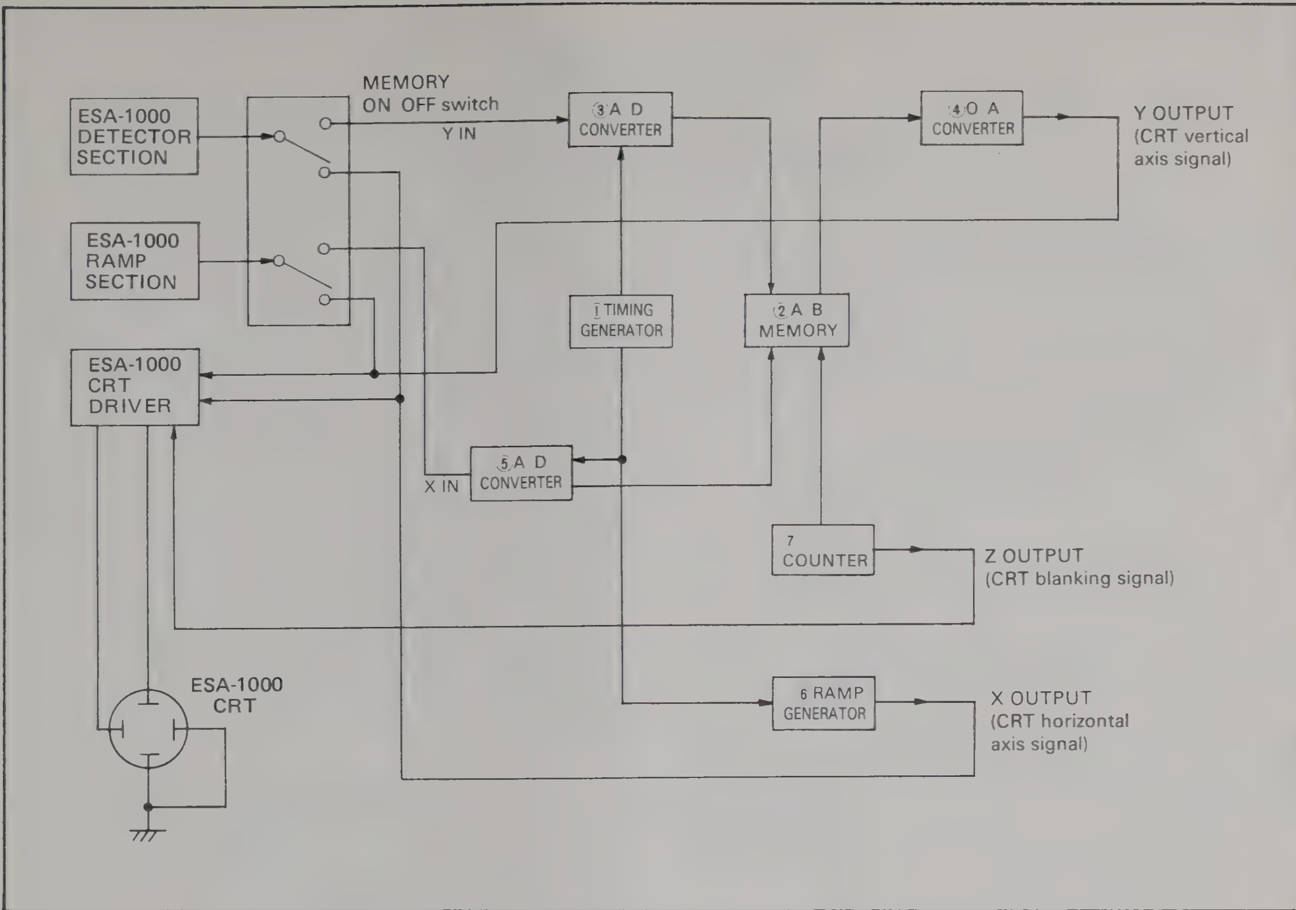


Figure 3.23 DM-1000 Block Diagram

3.6.7 DM-1000 BLOCK DIAGRAM

1. Timing generator: Generates the timing signals for control of the various memory unit stages.
2. A and B memory: Includes two pages composed of 256 points on the vertical axis and 512 points on the horizontal axis per page.
3. A/D converter (Y stage): Samples the vertical axis analog signals and converts them to digital forms.
4. D/A converter: Converts the vertical axis data stored in digital form in the memory to an analog signal and applies it to the vertical axis of the CRT.
5. A/D converter (X stage): Converts the horizontal analog signals to digital forms.
6. Ramp generator: Generates the approximately 4 msec. rampurances for which are applied to the input of the horizontal axis of the CRT.
7. Counter: Digital counter for the memory section (counts from 1 to 512) and supplies the blanking signal to the CRT.

SECTION IV
Performance Check

4.1 GENERAL

The performance tests listed in this section are designed to give specific information on the operational status of the instrument. The results of these tests will indicate whether the ESA-1000 is performing within specification limits and whether repair or recalibration is required. The following test procedures should be performed as part of the incoming inspection check and the results recorded for future reference as a standard for maintenance level testing and troubleshooting.

Table 4.1 lists the recommended test equipment and its performance ratings. (NOTE: Any equivalent test equipment with similar ratings can also be substituted).

4.2 WHEN TO UTILIZE TEST PROCEDURES

The performance test procedures should be used as follows:

a. As part of the incoming inspection check, with the results recorded for future reference.

b. As part of the periodic maintenance/calibration test check after every 500 hours of use.

c. As part of the repair procedure to locate malfunctioning circuits.

4.3 PRELIMINARY PRECAUTIONS

4.3.1 Always follow the operational precautions of Section 3.2 (Operational Precautions).

4.3.2 If the instrument has the optional DM-1000 Digital Memory unit, set the MEMORY ON/OFF to OFF and the A, A/B switch to A before AC power activation.

4.4 PERFORMANCE TEST PROCEDURES

TABLE 4.1 Recommended Test Equipment

Equipment	Performance Ratings	Recommendation
Signal Generator	Frequency: 1 MHz to 500 MHz Output level: 117 dBμ (50 Ω) Output impedance: 50 Ω Output level flatness: Within ± 0.5 dB Frequency accuracy: Within ± 1% Noise sideband: −140 dB away from 200 Hz carrier	Hewlett Packard 8640B
Frequency Counter	Frequency: 10 Hz to 100 MHz Sensitivity: 10 mVrms Stability: 5×10^{-8}/day	
High Frequency Power Meter	Frequency: 100 kHz to 1500 MHz Sensitivity: −30 dBm to +20 dBm Accuracy: ± 0.5 dB	Hewlett Packard 435B with 8484A Power Senser
Attenuator	Frequency: DC to 500 MHz Attenuation: 0 to 80 dB on 10 dB step Accuracy: ± 1.5 dB	Hewlett Packard 355D

4.4.1 Follow the power up procedure of Section 3.4.1 (General Power Up Procedure) from 3.4.1.1 to 3.4.1.7. Allow a minimum warmup period of approximately 30 minutes before proceeding with the following test procedures.

4.4.2 Initial Control Settings

Set the ESA-1000 front panel controls as follows:

INTENSITY	Center
FOCUS	Center
SCAN MODE	AUTO
DETECTION MODE	MEAN (VIDEO FILTER OFF)
SCAN TIME (MANUAL SCAN)	20 ms
REFERENCE LEVEL	INPUT LEVEL
VERTICAL AXIS SCALE SELECTOR	10 dB/DIV.
IF GAIN (dB)	0 dB, CAL.
RF. ATT.	0 dB
DISPERSION/DIV.	100 MHz/DIV.
B.W. (Hz) 6 dB	AUTO
TUNING/PRESET	TUNING

4.4.3 CAL OUTPUT CHECK

4.4.3.1 CAL OUT — Frequency Accuracy.

Specification: 100 MHz ± 0.20 MHz
Equipment used: Frequency Counter

a. Set the ESA-1000 front panel controls as per Section 4.4.2
b. Connect the CAL OUT of the instrument to the input of the Frequency Counter.
c. Verify that the counter reading is between 99.8 MHz and 100.2 MHz.

4.4.3.2 CAL OUT — Level Accuracy.

Specification: -27 dBM ± 0.5 BM.
Equipment used: Power Meter

a. Set the ESA-1000 front panel controls as per Section 4.4.2.
b. Connect the CAL OUT of the instrument to the input of the Power Meter and measure the level of the calibration signal.
c. Verify that the Power Meter reading is between -26.5 dB and -27.5 dBm

4.4.4 CRT DISPLAY-LOG Scale Accuracy

Specification: 0–3 dB ± 1.0 dB
30 dB–60 dB ± 1.0 dB
60 dB–70 dB ± 2.0 dB
Equipment used: Signal Generator
10 dB Step Attenuator

a. Set the ESA-1000 front panel controls as per Section 4.4.2 except for the following:

DISPERSION/DIV.	0.2 MHz/DIV.
B.W. (6 dB)	120 kHz
CENTER FREQUENCY	100 MHz
IF GAIN	10 dB OUTER, +5 dB INNER

b. Set the Signal Generator output to 100 MHz at a level of 95 dBuV and the 10 dB Step Attenuator to 0 dB. Connect the Signal Generator output via the Step Attenuator to the RF INPUT of the instrument.
c. Utilize the inner section of the IF GAIN switch to adjust the peak of the signal to match the top horizontal line (See Figure 4.1).
d. Change the external attenuator in 10 dB steps from 0 dB to 70 dB, while resetting the outer section of the IF GAIN switch from the 10 dB to the 0 dB position. When the input signal has been attenuated by 60 dB to 70 dB, measurements will be simplified if either the sweep rate is made slower or the manual scan mode is selected.
e. Verify that the signal amplitude level changes 10 dB ± 1 dB for a 10 dB change by the external attenuator over the range 0 dB to 30 dB, 10 dB ± 1.5 dB over the range 40 dB to 70 dB, and 10 dB ± 2 dB over the range 70 dB to 80 dB.
f. Reset the external attenuator to the 0 dB position and the outer section of the IF GAIN switch to the 10 dB position. Set the Vertical Axis Scale Selector switch to the 5 dB/DIV. position.
g. Adjust the V. REF. control located on the left side of the instrument (see Figure 3.9) to set the peak of the signal to the top horizontal line.
h. Verify that the amplitude level error of the signal peak is within 0.2 divisions when the external attenuator is changed in 10 dB steps from 0 dB to 40 dB (Figure 4.2A).
i. Set the inner section of the IF GAIN switch to the CAL position. Change the external attenuator in 10 dB steps from 0 dB to 30 dB.

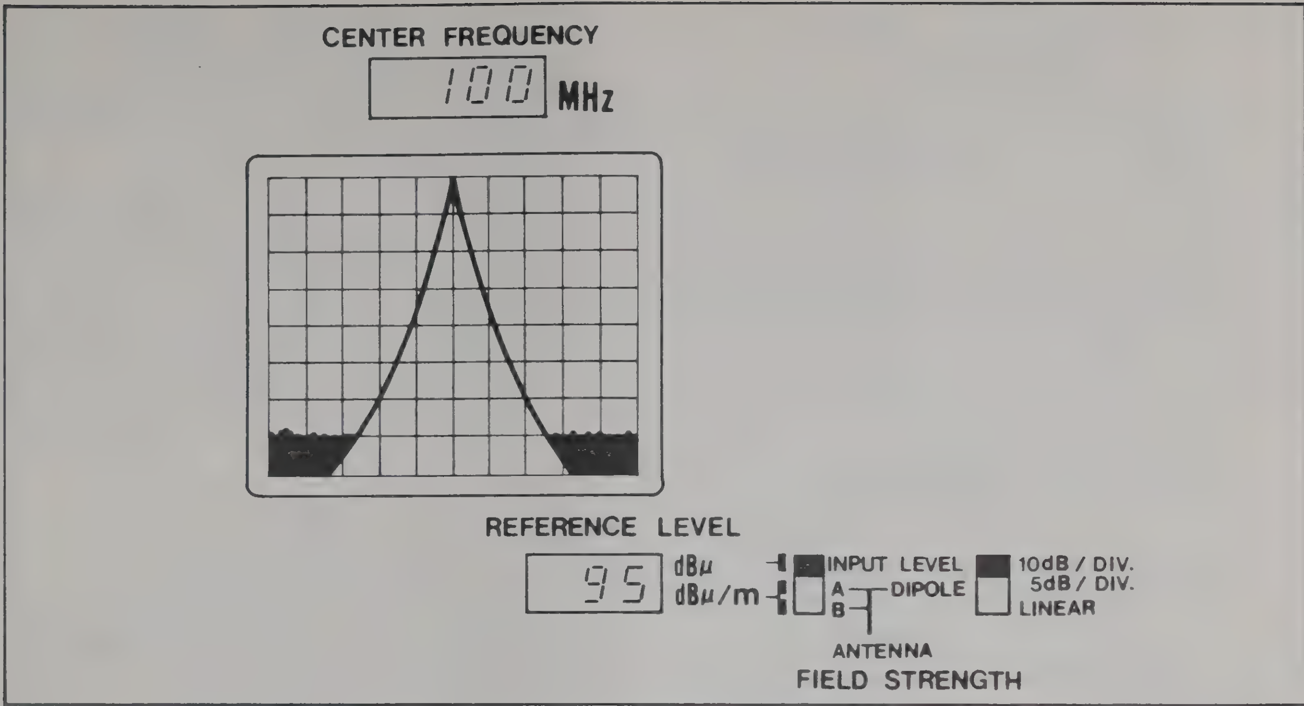


Figure 4.1 CRT LOG. Scale Accuracy Check Procedure

j. Verify that amplitude level error is within 0.2 divisions for each 10 dB step (Figure 4.2B).

4.4.5 IF GAIN Accuracy

Specification: ± 0 dB
Equipment used: Signal Generator
10 dB Step Attenuator

a. Set the ESA-1000 fron panel controls as Section 4.4.2 except for the following:

CENTER FREQUENCY .... 100 MHz
DISPERSION/DIV. .... 0.2 MHz/DIV.
B.W. (6 dB) .... 120 kHz
VERTICAL AXIS SCALE
SELECTOR.................... 5 dB/DIV.

b. Set the Signal Generator output to 100 MHz at a level of 95 dBuV and the 10 dB Step Attenuator to 0 dB. Connect the Signal Generator output via the Step Attenuator to the RF INPUT of the instrument.
c. Adjust the IF GAIN-CAL switch to place the peak of the signal at the center of the CRT DISPLAY (Figure 4.3).
d. Check that the level error of the signal peak from the graticule center is within 0.2 divisions (1 dB) for the combination settings of IF GAIN outer dial (0, 10, 20, 30 dB) and the Attenuator as follows:

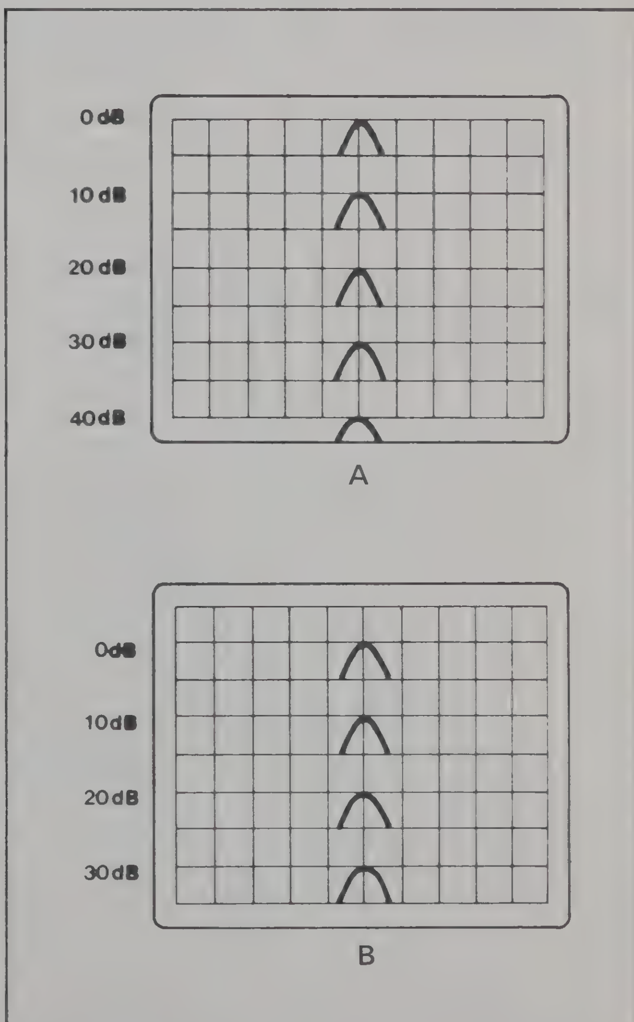


Figure 4.2 A/B CRT LOG. Scale Error Display

TABLE 4.2
IF GAIN Accuracy Test Settings of
IF GAIN & Ext. ATT.

IF GAIN Setting	External Attenuator Setting
10 dB	10 dB
20 dB	20 dB
30 dB	30 dB

4.4.6 RF ATTENUATOR Accuracy

Specification: ± 0.5 dB
Equipment used: Signal Generator
10 dB Step Attenuator

a. Set the ESA-1000 front panel controls as per Section 4.4.2 except for the following:

CENTER FREQUENCY .... 100 MHz
DISPERSION/DIV .... 0.2 MHz/DIV.
B.W. (6 dB) .... 120 kHz
VERTICAL AXIS SCALE S
SELECTOR.................... .5 dB/DIV.
IF GAIN .... 20 dB, CAL.

b. Retaining the test equipment setup of Section 4.4.5 set the Signal Generator output level to 110 dBuV at a frequency of 100 MHz. Set the 10 dB Step Attenuator for 40 dB of attenuation.

c. Adjust the IF GAIN-CAL switch to place the peak of the signal at the center of the CRT DISPLAY (Figure 4.4).

d. Change the instrument's RF ATTENUATOR and the external Attenuator settings as listed in Table 4.3. Verify that the error from the center of the CRT DISPLAY is within 0.1 divisions (0.5 dB) at all settings.

TABLE 4.3
RF. ATT. Accuracy Test/Settings
or RF. ATT. & Ext. ATT.

RF ATT. Setting	External ATT. Setting
10 dB	30 dB
20 dB	20 dB
30 dB	10 dB
40 dB	0 dB

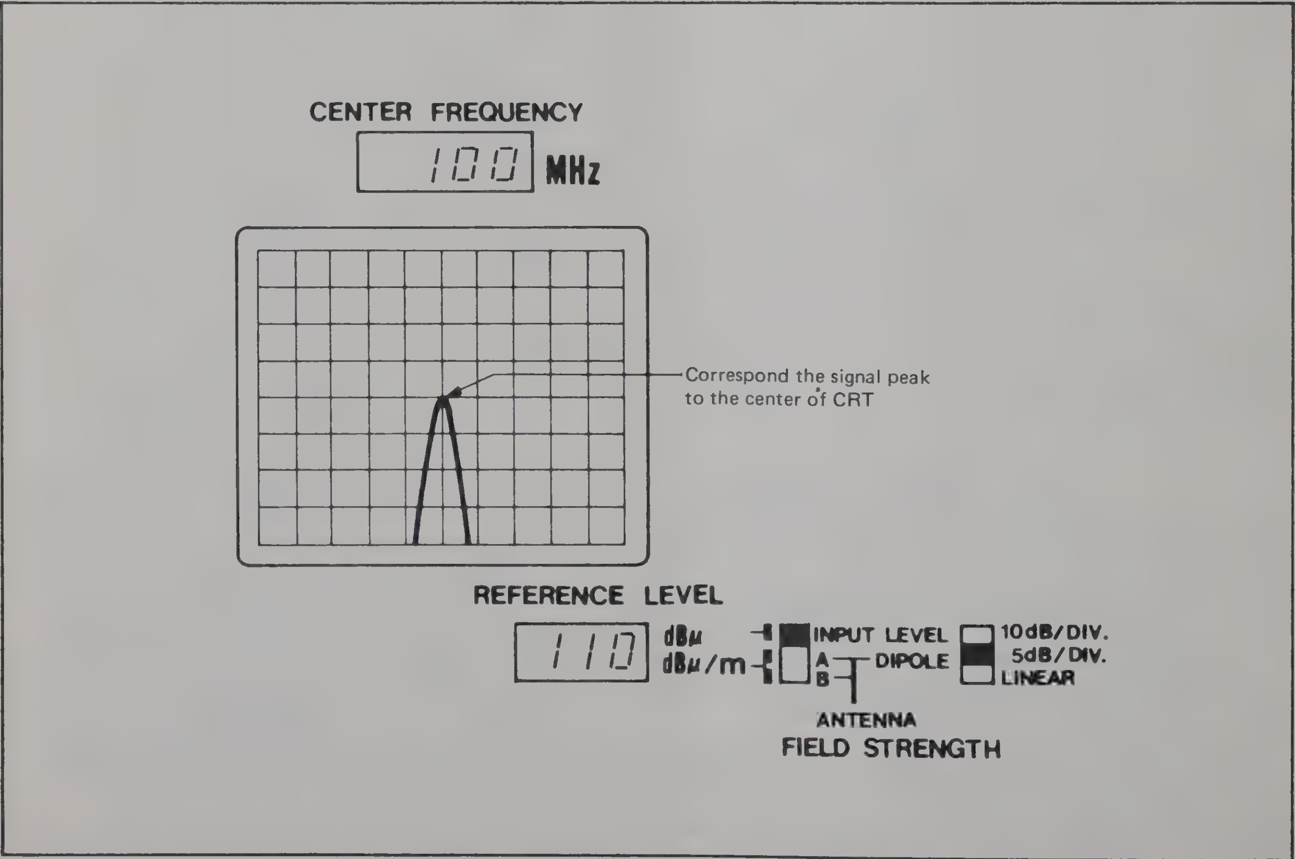


Figure 4.3 IF GAIN Accuracy Test Procedure

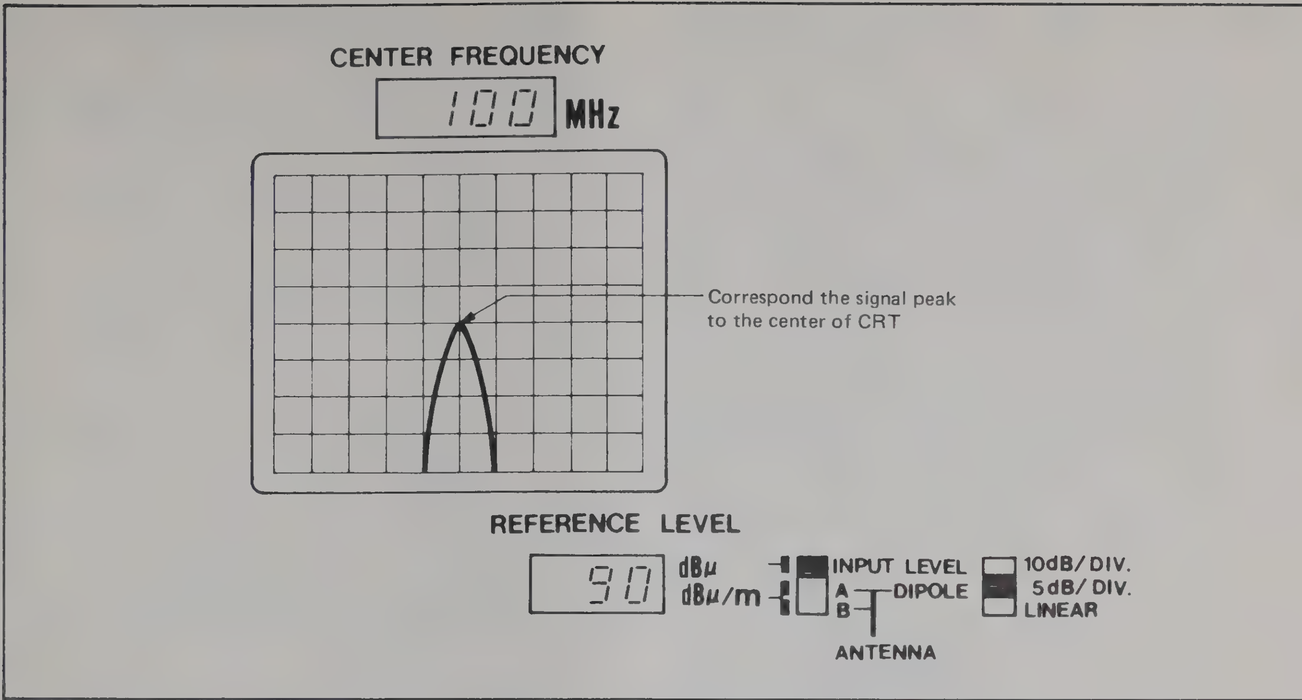


Figure 4.4 RF. ATT. Accuracy Test Procedure

4.4.7 IF BANDWIDTH Accuracy

Specification: Within ± 20%
Equipment used: Signal Generator.

a. Set the ESA-1000 front panel controls as per Section 4.4.6a. The procedure will indicate when control setting changes are required.
b. Set the Signal Generator output level at approximately 96 dBuV with the frequency set at 100 MHz. Connect the output of the generator to the RF INPUT of the instrument.
c. Set B.W. (6 dB) to 1.5 MHz and DISPERSION/DIV., to 0.5 MHz/DIV. respectively. Set the Vertical Axis Scale Selector Switch to the 10 dB/DIV. position.
d. Adjust the Signal Generator output level so that the signal peak on the CRT display comes to 6 dB above the horizontal center (Figure 4.5).
e. Check that the frequency difference between two points where the signal crosses the horizontal center line is in the range from 1.2 MHz to 1.8 MHz.
f. Reset B.W. (6 dB) to 120 kHz and DISPERSION/DIV. to 0.1 MHz/DIV. Proceed the same test as in steps e and f above and check that the frequency difference is within 96 kHz to 144 kHz.

4.4.8 BANDWIDTH SELECTIVITY

Specification: 60 dB Bandwidth Resolution/Bandwidth Ratio 15:1.
Equipment used: Signal Generator

a. Set the ESA-1000 front panel controls as per Section 4.4.2. The procedure will indicate when control setting changes are required.
b. Retaining the same test setup as per Section 4.4.7, set the Signal Generator output level at approximately 100 dBuV at a frequency of 100 MHz.
c. Set B.W. (6 dB) to 1.5 MHz and DISPERSION/DIV. to 0.5 MHz/DIV.

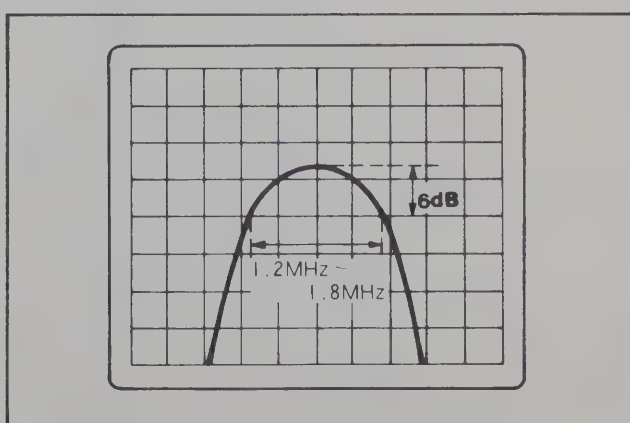


Figure 4.5 IF Bandwidth Accuracy Test Display

d. Set IF GAIN to 10 dB, and REFERENCE LEVEL will display 100 dBuV (Figure 4.6).
e. Adjust the Signal Generator output level and correspond the signal peak on the CRT display to the horizontal top line.
f. Read the bandwidth on the display at a point 60 dB below the signal peak. Verify that the bandwidth is less than 11.5 MHz (=1.5 MHz x 15).
g. Reset B.W. (6 dB) to 120 kHz and DISPERSION/DIV. to 0.2 MHz/DIV. Proceed with the same test as in steps d and e above, and read the bandwidth at 60 dB below the signal peak. Verify that the bandwidth is less than 1.8 MHz (=120 kHz x 15).
h. Set B.W. to AUTO and DISPERSION/DIV. to 0.1 MHz/DIV. The bandwidth is automatically set to 10 kHz on the 3 dB-bandwidth in this case. Read the bandwidth at 60 dB below the signal peak and verify that it is less than 150 kHz.

4.4.9 BANDWIDTH SWITCHING LEVEL ERROR

Specification: Within ± 1.0 dB
Equipment used: Signal Generator.

a. Set the ESA-1000 front panel controls as per Section 4.4.2. The procedure will indicate when control setting changes are required.
b. Retaining the same test setup as Section 4.4.8, set the Signal Generator output level at 90 dBuV at a frequency of 100 MHz.

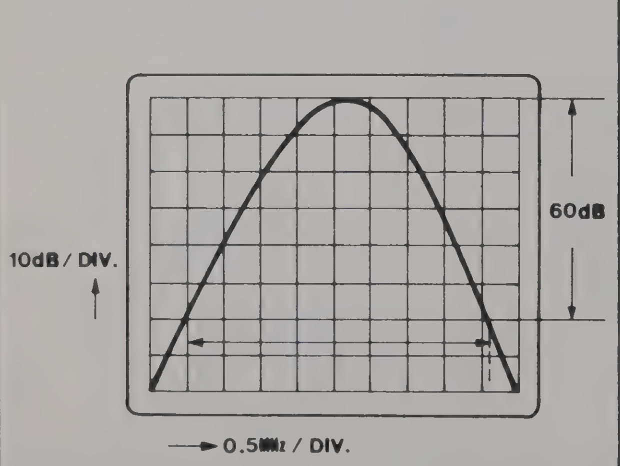


Figure 4.6 Bandwidth Selectivity Test Display

TABLE 4.4 Relation of DISPERSION/DIV. and BANDWIDTH in AUTO mode.

DISPERSION/DIV.	IF Bandwidth (3 dB)
100 MHz 50 MHz	300 kHz
20 MHz 10 MHz 5 MHz	100 kHz
2 MHz 1 MHz 0.5 MHz	30 kHz
0.2 MHz 0.1 MHz	10 kHz
ZERO	300 Hz

c. Set the Vertical Axis Scale Selector switch to the 5 dB/DIV. position and set the SCAN TIME Control at its mechanical center point (WHITE LINE – 12 o'clock).
d. As the DISPERSION/DIV. switch is switched clockwise, the 3 dB IF Bandwidth will change as per Table 4.4. The TUNING CONTROL is utilized to keep the signal centered on the CRT-DISPLAY.
e. Switch DISPERSION/DIV. from 100 MHz/DIV. to 0.1 MHz/DIV. in sequence and observe the signal level at each bandwidth. Then, keeping DISPERSION/DIV. at 0.1 MHz/DIV., switch B.W. counterclockwise in the sequence of AUTO – 9 kHz – 120 kHz – 1.5 MHz, and observe the signal level. Verify that the level difference between the highest and the lowest levels obtained during this procedure is within 1 dB (Figure 4.7).

4.4.10 FREQUENCY DISPLAY Accuracy

Specification: Within ± 10 MHz
Equipment used: Signal Generator and Frequency Counter.

NOTE: If the H.P. 8640B Signal Generator is utilized, the frequency can be read directly off the generator's frequency counter.

a. Set the ESA-1000 front panel controls as per Section 4.4.2 except for the following:

SCAN TIME	Mechanical Center
DISPERSION/DIV.	5 MHz/DIV.

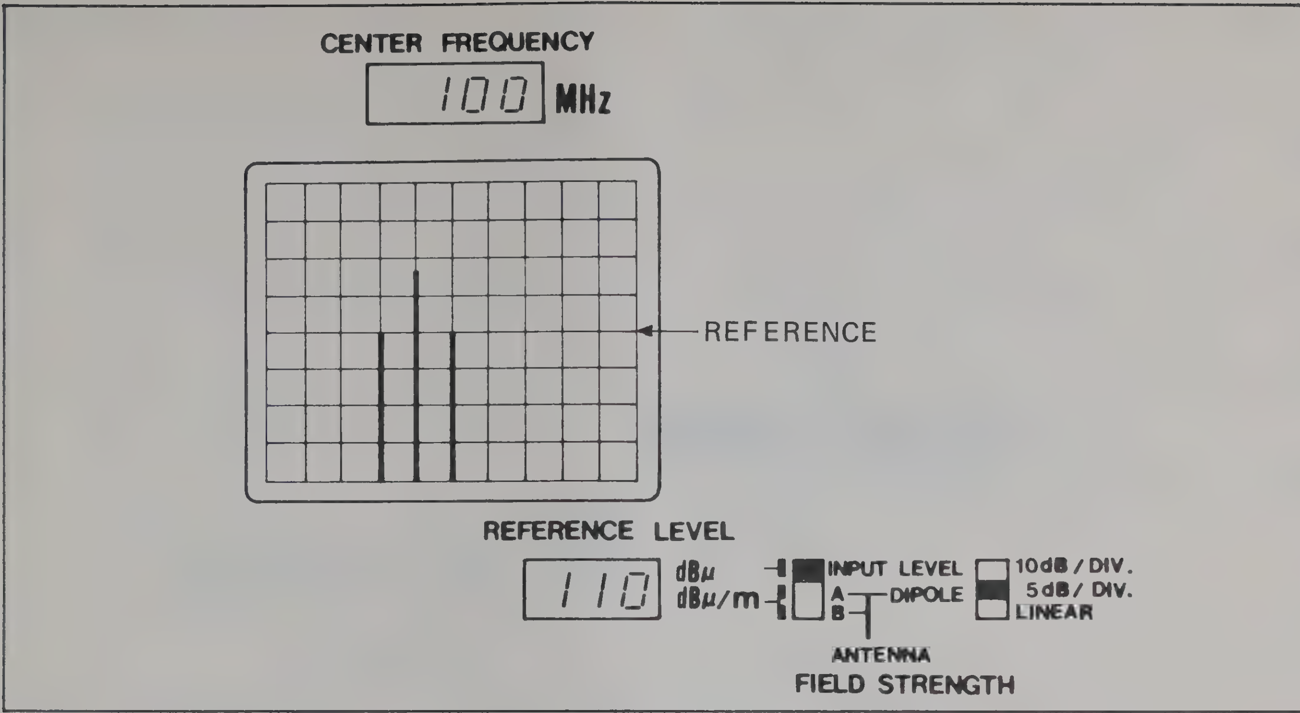


Figure 4.7 Bandwidth Switching Level Error Test Procedure

b. Retaining the same test setup as Section 4.4.9, set the Signal Generator output level at +120 dBuV and the output frequency at 100 MHz ± 50 MHz.
c. Adjust TUNING to center the zero frequency (Local feed through).
d. Reset DISPERSION/DIV. to 100 MHz/DIV. and return it to 5 MHz/DIV.
e. Adjust TUNING FINE to keep the zero frequency to the center.
f. Adjust ZERO ADJ. if necessary so that CENTER FREQUENCY indicates 000 MHz.
g. Turn TUNING to locate the 100 MHz signal and its harmonics one after the other to the center. Repeat the same procedure to the 10th harmonic, and read respective indication on CENTER FREQUENCY.
h. Verify that the indication error for 100xN (where N is the corresponding harmonic from 1st to 10th) is within ± 10 MHz.
i. Next, turn TUNING counter-clockwise and repeat the same procedure as in steps g and h above. Read the error and also verify that it is within ± 10 MHz.

4.4.11 FREQUENCY RESPONSE

Specification: <± 1.0 dB over the frequency range of 100 kHz to 1000 MHz.
Equipment used: Signal Generator

a. Set the ESA-1000 front panel controls as per Section 4.4.2 except for the following:

CENTER FREQUENCY .... 500 MHz
VERTICAL AXIS SCALE
SELECTOR .... 5 dB/DIV.
IF GAIN .... 20 dB
RF. ATT. .... 0 dB
SCAN TIME .... Mechanical Center

b. The test set up is the same as utilized in Section 4.4.9. Set the Signal Generator output level at 80 dBuV and the output frequency at 100 MHz.
c. The resultant trace on the CRT DISPLAY, with the amplitude level established at the center horizontal line, will be used as the reference point.
d. Slowly tune the Signal Generator across the frequency range of 100 kHz to 1000 MHz, with the output level at 80 dBuV and the output frequency at 100 MHz.
e. The resultant trace on the CRT DISPLAY, with the amplitude level established at the center horizontal line, will be used as the reference point.
f. Slowly tune the Signal Generator across the frequency range of 100 kHz to 1000 MHz, with the output level fixed at 80 dBuV. Verify that the amplitude level remains within ±1.0 dB of the reference point across the entire frequency range.

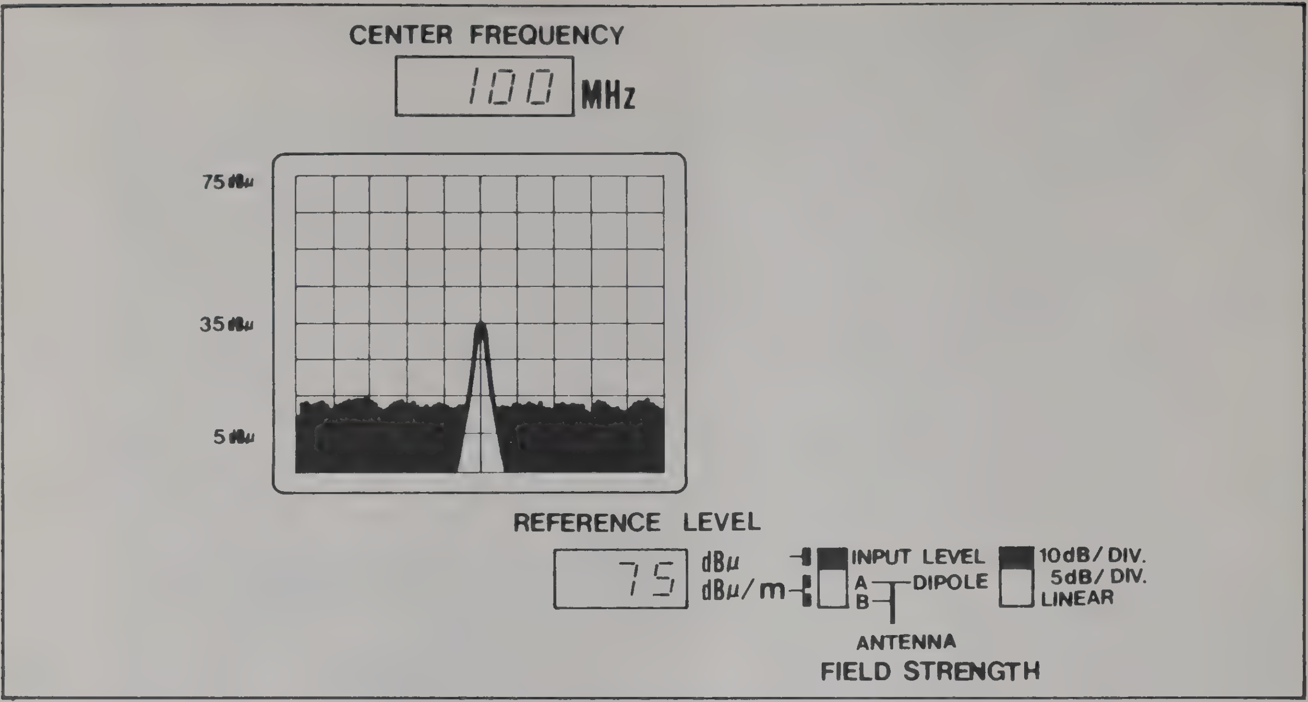


Figure 4.8 Average Noise Level Test Procedure

4.4.12 AVERAGE NOISE LEVEL

Specification: <5 dBuV with IF Bandwidth at 10 kHz, Video Filter at 100 Hz

Equipment used: Signal Generator
10 dB Step Attenuator

a. Set the ESA-1000 front panel controls as per Section 4.4.2 except for the following:

CENTER FREQUENCY .... 100 MHz
SCAN TIME ....White-line at 12 o'clock
IF GAIN .... 30 dB, +5 dB
DISPERSION/DIV. .... 0.1 MHz/DIV.
B.W. .... AUTO

b. Set the Signal Generator to a frequency of 100 MHz and an output level of 85 dBuV. Connect the output of the Signal Generator via the 10 dB Step Attenuator, set at 50 dB of Attenuation, to the input of the instrument.
c. Adjust the IF GAIN-CAL control to center the signal on the CRT DISPLAY (Figure 4.8).
d. Disconnect the Signal Generator input from the instrument and set the VIDEO FILTER to 100 Hz.
e. Set the SCAN TIME to a slower rate and verify that the average noise level is below 5 dBuV (Figure 4.9).

4.4.13 SPURIOUS RESPONSE

Specifcation: -70 dB or less (RF ATTENUATOR 0 dB, input level 80 dBuV)

Equipment used: Signal Generator
Low Pass Filters, with cutoff frequencies of 10, 20, 30, 50, 70, 100, 150, 200, and 250 MHz respectively. Attenuation characteristics > 40 dB/octave.

a. Set the ESA-1000 front panel controls as per Section 4.4.2, except for the following:

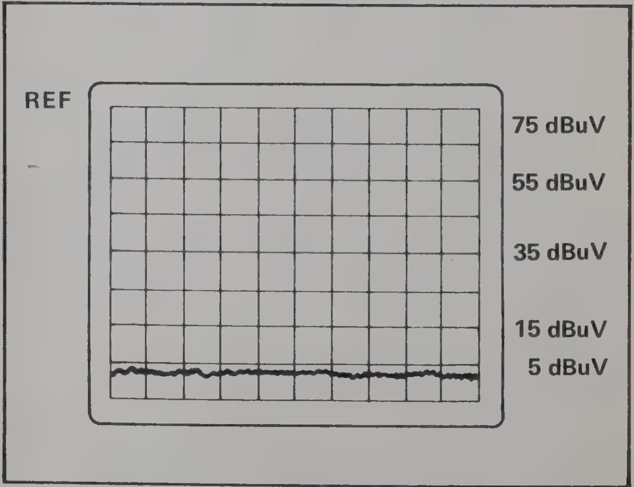


Figure 4.9 Average Noise Level Test Display

CENTER FREQUENCY..............500 MHz
IF GAIN............................10 dB

b. Set the Signal Generator frequency at 10 MHz and the output level at 100 dBuV. Connect the output of the generator, via the selected Low Pass Filter to the INPUT of the instrument.
c. Adjust the IF GAIN-CAL control to match the input signal level to the top horizontal line.
d. On the CRT DISPLAY, observe that the second harmonic of the signal is more than 50 dB below the fundamental signal (Figure 4.10).
e. Repeat the above procedure for the following frequencies: 20 MHz, 30 MHz, 50 MHz, 70 MHz, 100 MHz, 150 MHz, 200 MHz, and 250 MHz.

4.4.14 NOISE SIDEBAND

Specification: -70 dB Below signal level (IF Bandwidth 10 kHz, 200 kHz away from carrier)
Equipment used: None

a. Set the ESA-1000 front panel controls as per Section
b. Set the DISPERSION/DIV. to 0.1 MHz/DIV. and center the zero frequency (local feedthrough) on the CRT DISPLAY using the TUNING control.
c. Use the IF GAIN-CAL control (outer and inner) to position the zero frequency peak to the horizontal line (Fig. 4.11).
d. Observe that the peak level of the noise is -70 dB or lower at a point 200 kHz away from the signal center.

4.4.15 FREQUENCY STABILITY

Specification: <200 kHz/5 minutes drift
Equipment used: Stop-Watch

a. Utilize same ESA-1000 control settings and procedure as Section 4.4.14.
b. Observe the zero frequency signal for 5 minutes after centering the signal and note that it is within ±2 divisions (±200 kHz) from the initial location.

4.4.16 RESIDUAL FM

Specification: Within 10 kHz P-P
Equipment used: None

a. Set the ESA-1000 front panel controls as per Section 4.4.2 except for the following:

SCAN TIME....................White-line at 12 o'clock
DISPERSION/DIV .... 0.1 MHz/DIV.
B.W. (6 dB) ....9 kHz

b. Use the IF GAIN-CAL control (inner and outer) to position the peak of the zero frequency signal at the top horizontal line (Figure 4.12A).

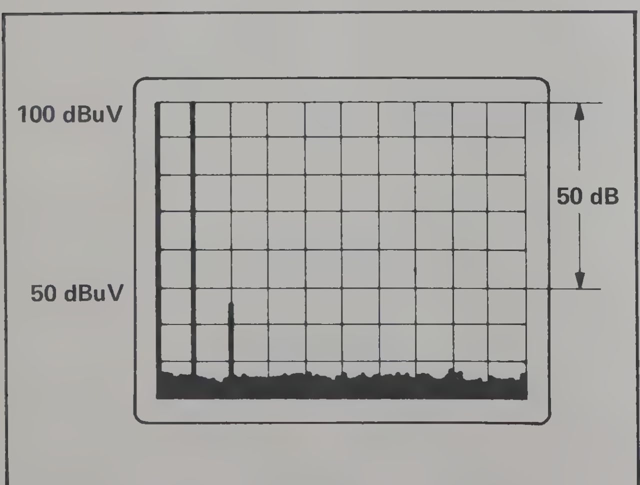


Figure 4.10 Spurious Response Test Display (example: 100MHz signal)

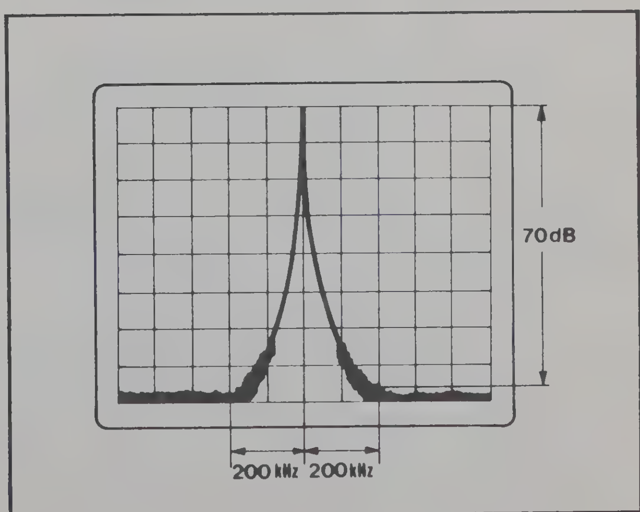


Figure 4.11 Noise Sideband Test Display

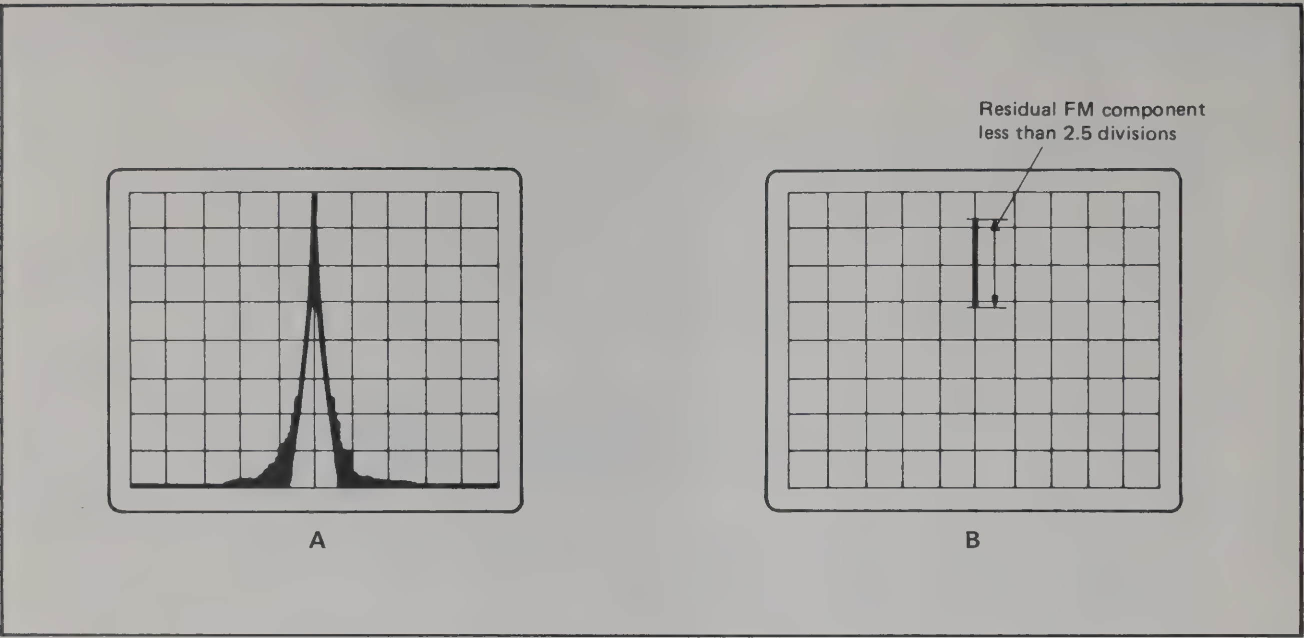


Figure 4.12 A/B Residual FM Test Display

c. Set the SCAN MODE switch to the MANUAL position and center the bright spot on the CRT DISPLAY by using the SCAN TIME control.
d. Position the bright dot to the second horizontal line from the top by using the TUNING (coarse and fine) control (Figure 4.12B).
e. Observe that the peak to peak width of the bright spot is less than 2.5 divisions.

4.4.17 RESIDUAL SPURIOUS RESPONSE

Specification: <20 dBuV (no input signal, RF ATTENUATOR 0 dB)
Equipment used: None

a. Set the ESA-1000 front panel controls as per Section 4.4.2 except for the following:

SCAN TIME . . . . 11 o'clock
IF GAIN . . . . .30 dB
DISPERSION/DIV. . . . . .20 MHz/DIV.

b. With no signalinput to the instrument, utilize the TUNING control and slowly tune across the 100 kHz to 1000 MHz frequency range of the unit.
c. Observe that the residual response does not exceed 20 dBuV.

SECTION V
Service, Maintenance and Calibration

5.1 GENERAL

This section provides the information necessary for the proper maintenance, calibration, troubleshooting, and repair of the ESA-1000 Spectrum Analyzer. Failure to follow these procedures could violate the terms of the manufacturer's warranty, plus compromise the reliability, operation, and integrity of the instrument.

5.2 MAINTENANCE/CALIBRATION/REPAIR

5.2.1 Maintenance. To ensure accurate and trouble-free operation of the ESA-1000, it is recommended that a periodic maintenance schedule be initiated on a six month or 500-750 hours of operational time basis. The performance test procedures of Section IV should be included as part of the maintenance procedure to assess the instrument's overall performance.

5.2.2 Calibration. The calibration procedures of Section 5.7 are utilized as follows:

a. To align and recalibrate the instrument after repair work has taken place.
b. As part of the periodic maintenance schedule to maintain the accuracy of the instrument to the required specifications.

5.2.3 Repair. Repair should be undertaken when one of the following conditions exists:

a. There is an obvious fault in the instrument's operation.
b. Operation is outside the specification limits and cannot be restored by recalibrating the ESA-1000.

5.3 PRELIMINARY PRECAUTIONS AND CONSIDERATIONS

WARNING
HIGH VOLTAGE

Voltages of up to 2 KV or greater are present in this instrument. Use caution whenever working on or near the high voltage supplies or around the CRT. Serious injury or death may result from contact with the high voltage lines.

5.3.1 GENERAL PRECAUTIONS

a. The instrument is to be operated on 115 VAC ± 10% 50/60 Hz only.
b. The instrument should always be operated connected to a suitable ground plane either via the ground prong on the AC power cable or the ground terminal on the unit's rear panel.
c. Always place the instrument's AC power switch to OFF before proceeding to remove or replace components within the instrument.
d. Use caution when making power on measurements to prevent accidental shorting from occurring.
e. As noted above, the instrument utilizes high voltages up to 2 KV. Always exercise extreme caution when working or troubleshooting around the high voltage circuits. Before repairing/replacing or working on components in these sections, remove the unit totally from the AC power source and wait a minimum of 5 minutes before proceeding.
f. If replacement of the CRT is required, it is recommended that the instrument be returned to the factory for this operation. When replacement in the field is necessary, follow the instructions given in Section 5.63 and contact Electro-Metrics or its representatives for assistance if required.
g. If it is determined that the RF Block (MEP-262) is defective, the block must be replaced. Again returning the instrument to the factory for RF Block replacement is recommended, when field replacement is necessary follow the instructions given in Section 5.6.5. Contact Electro-Metrics or its representatives for assistance if required.

NOTE: The protruding screw on the RF Block is for adjusting the 1153 MHz Band Pass Filter Cavity and the 2nd Local Oscillator. Do not adjust or accidentally turn this screw.

5.3.2 Table 5.1 gives the test equipment required to perform the calibration and troubleshooting procedures.

5.4 TROUBLESHOOTING

5.4.1 The procedure for troubleshooting the ESA-1000 is similar to that employed for other electronic equipment. This consists of pinpointing the source/cause of the malfunction by the process of logically eliminating alternate possibilities. By eliminating the greatest number of possibilities with one check, this process will quickly narrow the remaining choices until the defective component or circuitry is isolated.

To facilitate troubleshooting the ESA-1000, the Troubleshooting Sequence Guide Figure 5.22 through 5.34 can be utilized as a guide. Use the checkpoints and voltages listed to aid in isolating and determining the area of circuit malfunctioning. For any assistance required, contact the ELECTRO-METRICS CUSTOMER SERVICE DEPARTMENT (518-843-2600).

5.5 REPAIR PROCEDURES

5.5.1 Use the Troubleshooting Sequence Guide to isolate the section of the instrument where the circuit malfunction is occurring and its cause.

TABLE 5.1 Recommended Test Equipment

Equipment	Performance Ratings	Recommendation
Signal Generator	Frequency: 1 MHz to 500 MHz Output level: 117μ (50Ω) Output impedance: 50Ω Output level flatness: Within ± 0.5 dB Frequency accuracy: Within ± 1% Noise sideband: −140 dB away from 200 Hz carrier	Hewlett Packard 8640B
Frequency Counter	Frequency: 10 Hz to 100 MHz Sensitivity: 10 mVrms Stability: 5x10^{-8}/day	
High Frequency Power Meter	Frequency: 100 kHz to 1500 MHz Sensitivity: ≧30 dBm to +20 dBm Accuracy: ±0.5 dB	Hewlett Packard 435B with 8484A Power Senser
Attenuator	Frequency: DC to 500 MHz Attenuation: 0 to 80 dB on 10 dB step Accuracy: ±1.5 dB	Hewlett Packard 355D
Digital Voltmeter	Range: OV to ± 1000 V Accuracy: ±0.1% Input impedance: ≧ 10 MΩ	Datatech Model 40
DC High Voltage Probe	Range ±3000 VDC	
Oscilloscope	Frequency: DC to 10 MHz Sensitivity: 10 mV/DIV.	
Voltage Probe	Attenuation: 10 : 1 Input impedance: 10 MΩ Max. DC voltage: 500 V	

NOTE: Equivalent equipment can be substituted for those recommended.

5.5.2 Use the information obtained to determine whether to repair or replace the defective module, board, or component.

5.5.3 PRINTED CIRCUIT BOARD PRECAUTIONS

a. Do not remove circuit boards (or any other components) while power is applied to the unit. Always turn off and disconnect all external power before proceeding.
b. Never touch the printed surface with bare fingers; skin oils can create leakage paths.
c. Use a grounded soldering iron (20W to 30W) to avoid destruction of IC's and semiconductors.
d. Avoid excessive heat when repairing a board.
e. After repair, clean the printed surface of all contaminants, excess solder, and resin using a freon-base cleaner. Check that excess solder has not created new circuit paths.

NOTE: After any general repair work, always clean the repaired area with a freon-base cleaner.

5.6 DISASSEMBLY/REPLACEMENT

5.6.1 The majority of modules, P.C. boards, and subassemblies can be removed by following the ESA-1000 Assembly Guide Figure 7.

5.6.2 Top and Bottom Covers Removal. To remove the top and bottom covers from the unit, remove the four Phillips machine screws holding each cover. Each cover is then liften up and out. To replace the covers, reverse the procedure.

5.6.3 CRT REPLACEMENT

a. Remove the top and bottom cover as per Section 5.6.2.
b. Disconnect and remove the lead wires from the CRT coil as shown in Figure 5.1.
c. Remove the CRT DRIVER board (SG210) by removing the four Phillips machine screws and the two connectors from the board.
d. Remove the CRT socket marked 1 in Figure 5.2.
e. Loosen the four Phillips screws for the CRT band (marked 2 in Figure 5.2). For additional information see Figure 5.3.
f. Loosen the Phillips screw marked 3 in Figure 5.2.
g. Remove the entire CRT and shield assembly by pulling the assembly back from the front of the unit, then lifting up and out.
h. Carefully pull the CRT Tube through the front of the shield assembly.
i. Install a new CRT tube (Stock No. 140-BMB31) by reversing the procedure given above.
j. Perform the CRT DRIVER adjustment procedure of Section V.
k. Replace the top and bottom covers as per Section 5.6.2.

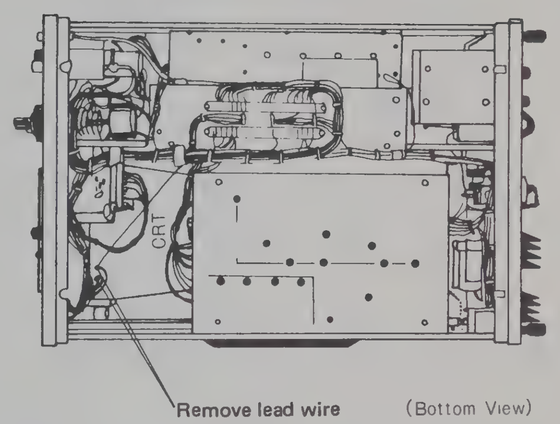


Figure 5.1 CRT Replacement
(Bottom View)

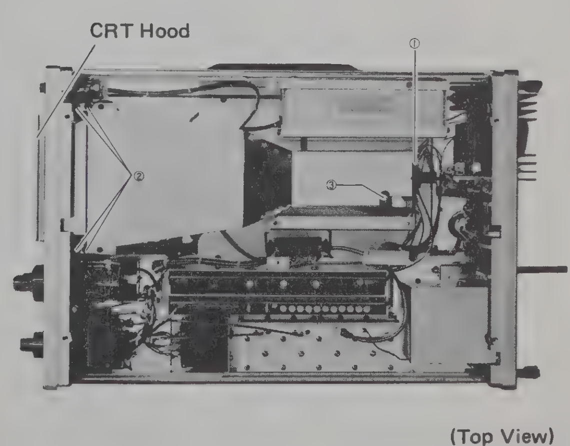


Figure 5.2 CRT Replacement
(Top View)

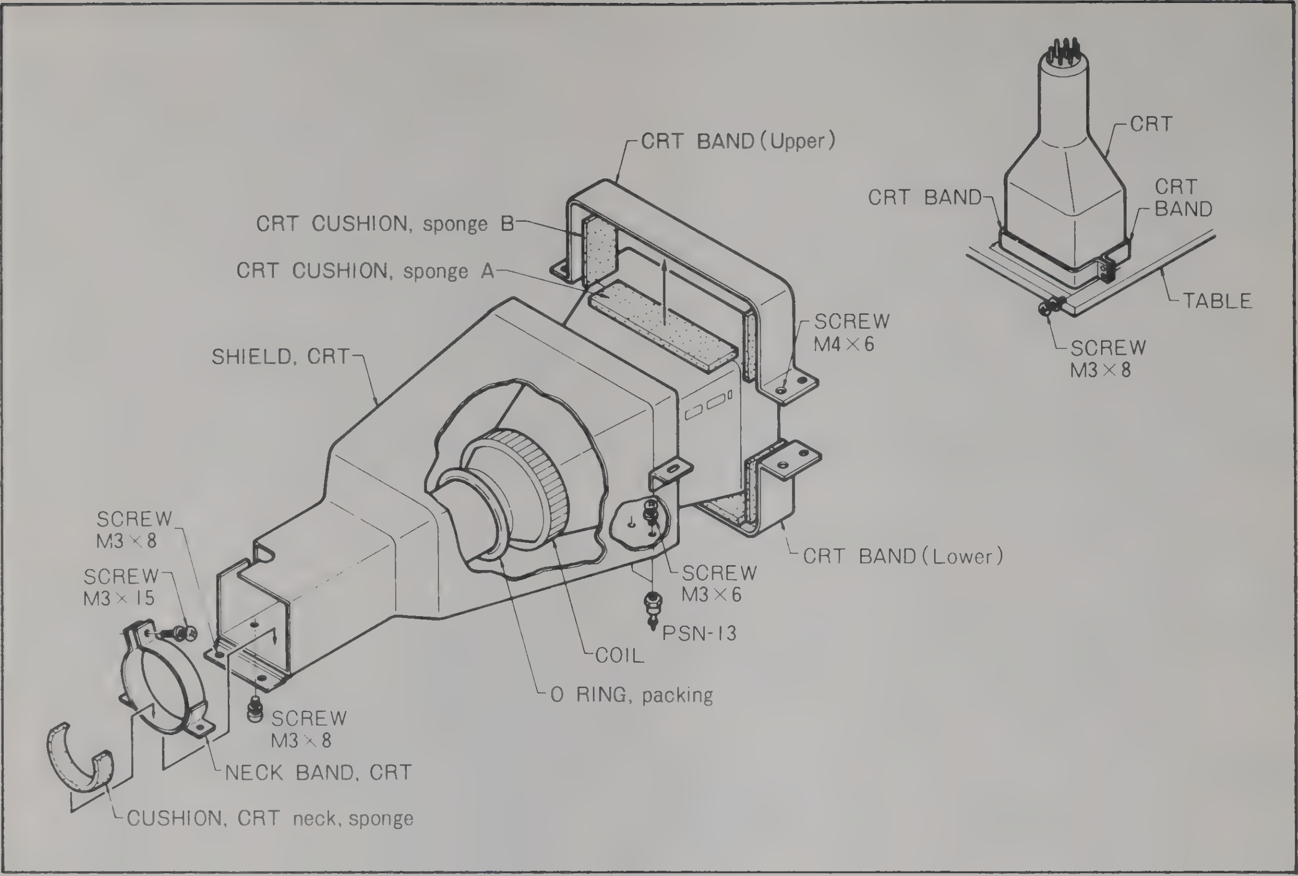


Figure 5.3 CRT Assembly Diagram

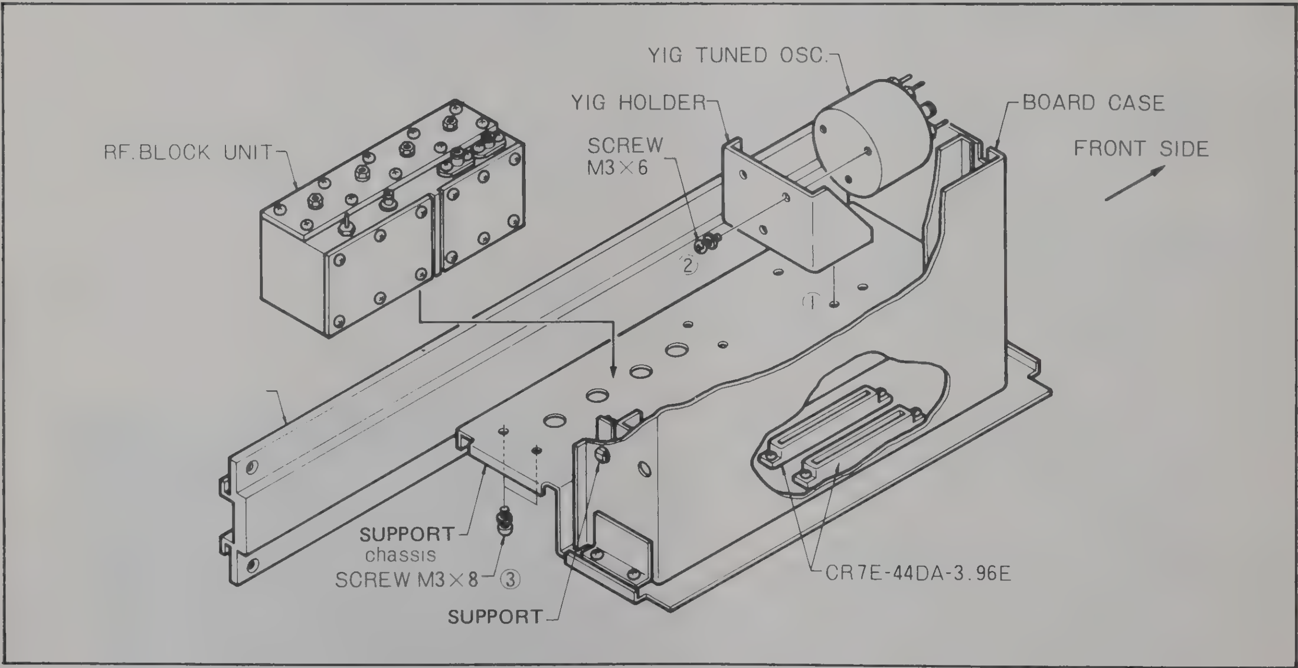


Figure 5.4 YIG & RF. BLOCK Assembly Diagram

1. If the CRT graticule and filter on the front of the unit requires cleaning, use either a solution of soap and water or an alcohol based glass cleaner. Wipe dry with a soft clean cloth.

NOTE: The front panel CRT Hood and filter can be removed by removing the four Phillips machine screw on the CRT Hood.

5.6.4 YIG TUNED OSCILLATOR REPLACEMENT

a. Remove the top and bottom covers as per Section 5.6.2.

b. Remove the four Phillips machine screws (marked 1 in Figure 5.4) which fasten the YIG holder bracket to the RF BLOCK Assembly.

c. Remove the wires connected to the YIG connector terminals.

d. Remove the three Phillips machine screws (marked 2 in Figure 5.4) which mount the YIG Oscillator to the YIG holder bracket.

e. Install a new YIG Oscillator (Stock No. MEP-158) by reversing the procedure given above. Take care to remount the YIG Oscillator and YIG holder bracket correctly.

f. Perform the Performance Tests in Section 4.4.11 and 4.4.13 and the calibration adjustment procedures Section 5.7.6.

5.6.5 RF BLOCK REPLACEMENT

a. Remove the top and bottom covers as per Section 5.6.2.

b. To remove the RF Block Assembly, remove the four Phillips machine screws which mount the assembly to the support bracket (marked 3 in Figure 5.4).

c. Install a new RF Block Assembly (Stock No. MEP-262) by reversing the procedure given above.

CAUTION

Do not accidentally adjust or move the projecting screw on the RF Block Assembly, which is for adjusting the 1153 MHz Band Pass Filter Cavity and the 2nd LO Oscillator.

d. Perform the calibration check of Section 5.7.8. (Optional).

5.7 CALIBRATION PROCEDURES

5.7.1 General. The calibration procedures for the ESA-1000 are normally utilized to recalibrate the instrument after repair work has been performed or when the performance test procedures of Section IV show the unit not meeting the required specifications. The test equipment required for calibration is listed in Table 5.1.

5.7.1.1 All the following procedures are performed with the POWER MODE switch set to the AC position and the unit connected to a 115 VAC ±10% 50/60 Hz power source. In addition the unit has both covers removed (See Section 5.6.2) for performing the adjustments and tests required.

5.7.2 INITIAL TESTS AND SETTINGS

5.7.2.1 POWER SUPPLY CHECKS

a. Starting with the AC POWER switch OFF — check the resistance to ground and with the AC POWER switch ON — the DC voltages on the following pins of connector J2 (located at the bottom of the unit) with a digital voltmeter.

Pin	DC Voltage	Resistance to Ground
J2-19A1B	+15 VDC ± 0.6 V	86 to 88 ohms
J2-18A1B	-15 VDC ± 0.6 V	86 to 88 ohms
J2-17A1B	+5 VDC ± 0.2 V	86 to 88 ohms

b. In the same manner check the resistance and DC voltages on the following:

IC4-Pin 2	+24 VDC ± 1.2 V	86 r to 88 r
D5 Cathode	Approx. 260 VDC	131 r to 133 r

These two components are located on the inside of the rear panel.

c. Checking the High Voltage Power Supply.

1. Set the AC POWER switch to OFF.
2. Remove the CRT DRIVER board (SG210) by removing the four Phillips machine screws and connection fastening it to the unit. Also remove the CRT socket from the rear of the CRT tube.
3. Proceeding with caution and care, measure the pin voltages on the CRT socket with a high voltage probe and digital voltmeter.

Pin 1, 14 (H)	-2.01 KV
Pin 2, (G1)[1]	-2.01 KV to -2.08 KV
Pin 3, (K)	-2.01 KV
Pin 4, (P1)[2]	-1.38 KV to -1.97 KV
Pin 6, (G2)	+100 VDC

1 : INTENSITY control voltage
2 : FOCUS control voltage

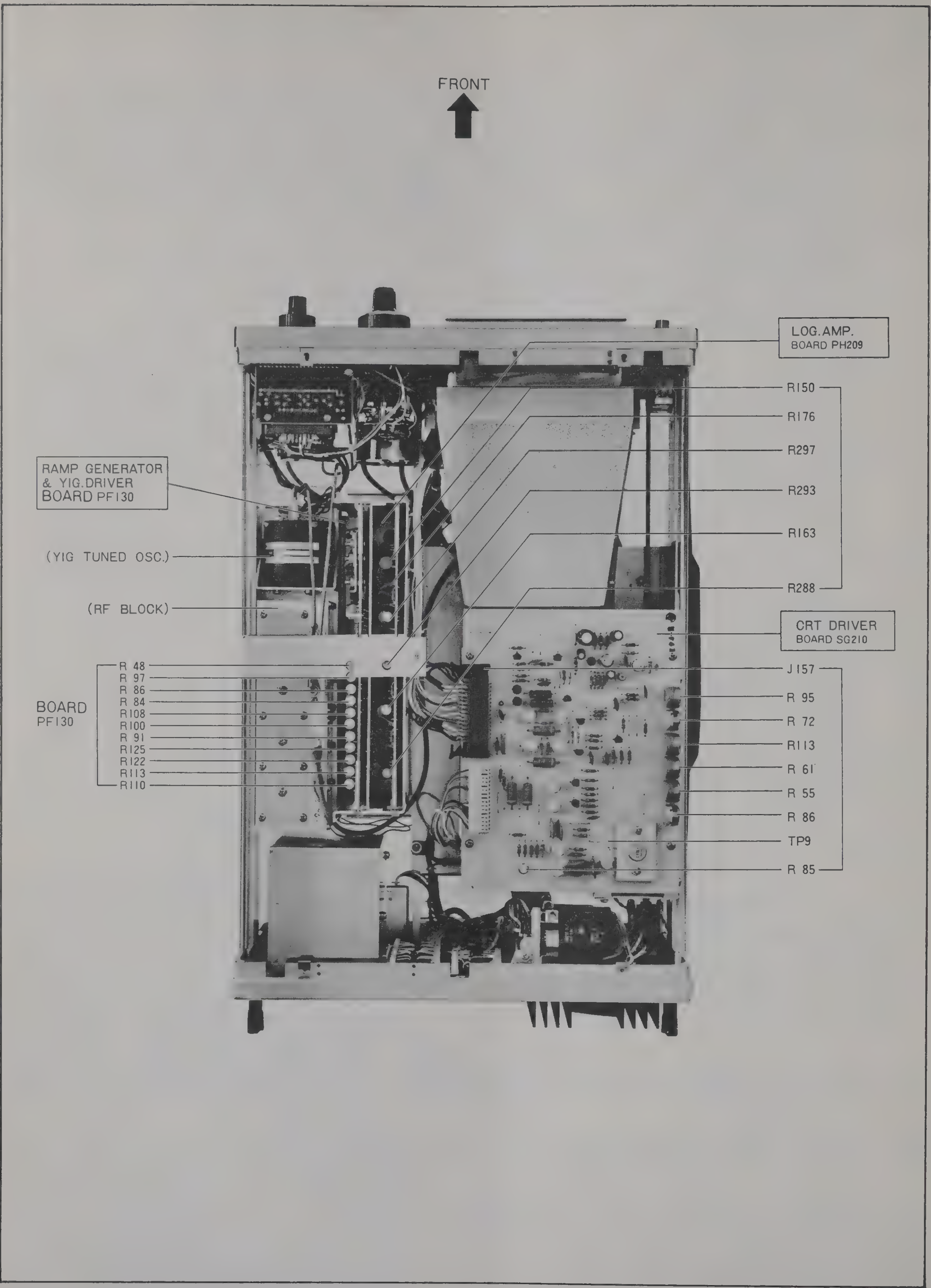


Figure 5.5 ESA-1000 Top View

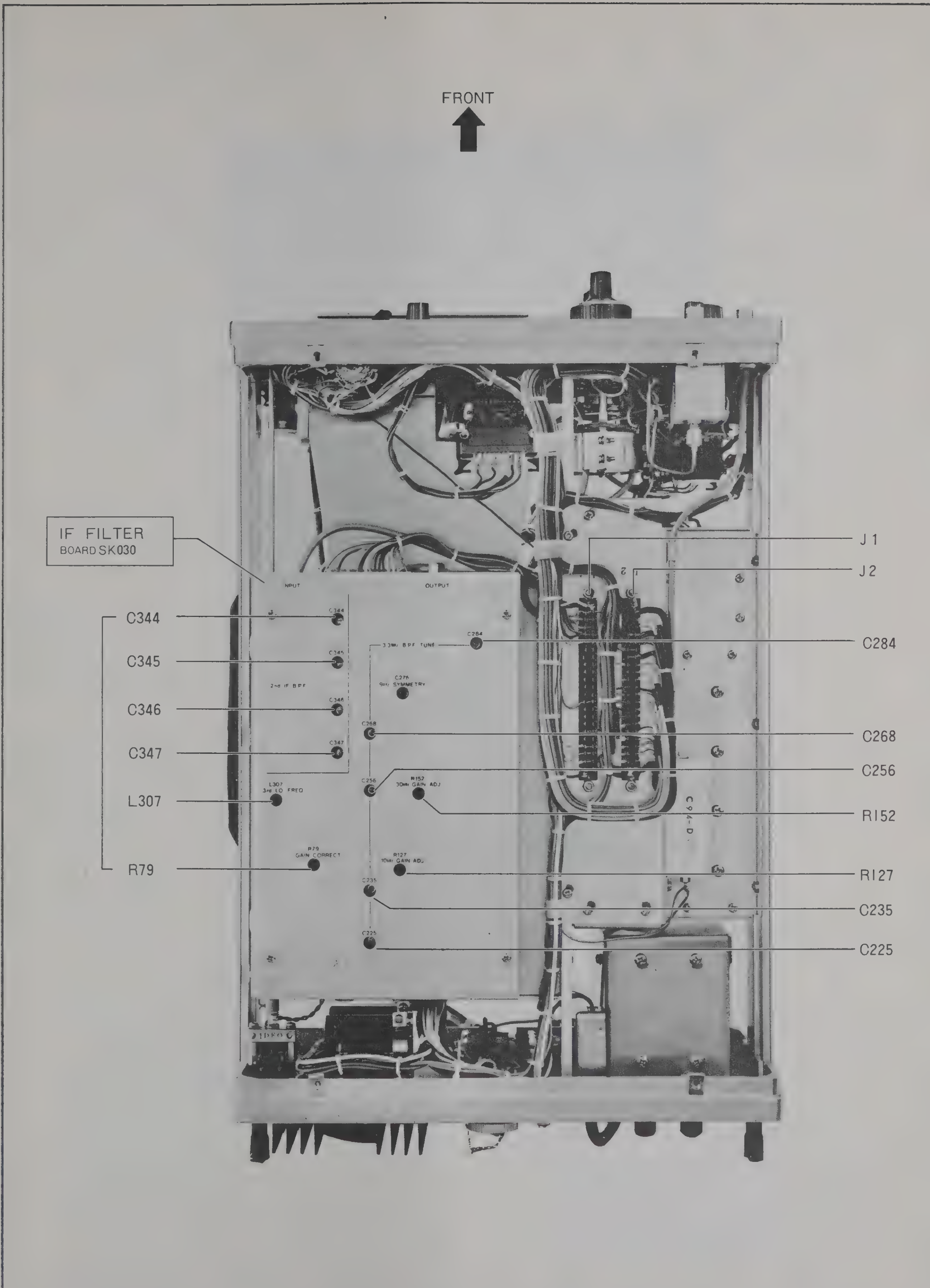


Figure 5.6 ESA-1000 Bottom View

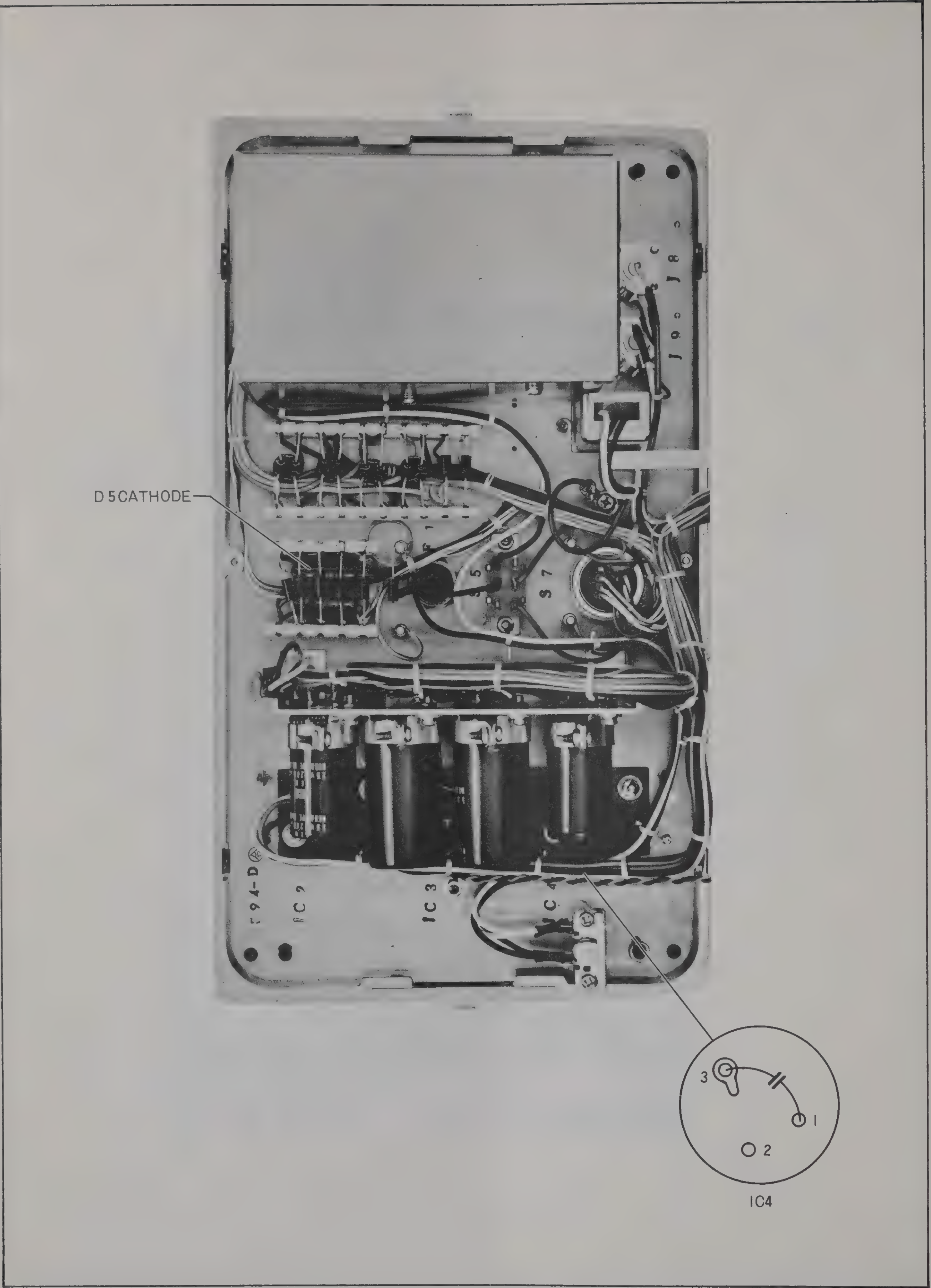


Figure 5.7 ESA-1000 Rear View

"WARNING"

Serious injury or death can result from contact with the high voltage lines. Always exercise extreme caution and care when working with or around high voltage. Remember careful, cautious, and correct is better than quick, damaged, and injured.

After the CRT voltages have been checked; turn the AC POWER OFF, connect the CRT socket to the CRT tube, and reconnect and fasten down the CRT DRIVER board SG210.

5.7.2.2 PRELIMINARY PROCEDURE

a. Set the ESA-1000 front panel controls as follows:

INTENSITY .... Center
FOCUS .... Center
SCAN MODE .... AUTO
DETECTION MODE .... MEAN (VIDEO FILTER OFF)
SCAN TIME (MANUAL SCAN) ....20 ms
REFERENCE LEVEL ....INPUT LEVEL
VERTICAL AXIS SCALE SELECTOR....................10 dB/DIV.
IF GAIN (dB) ....0 dB, CAL.
RF. ATT. ....0 dB
DISPERSION/DIV. .... 100 MHz
B.W. (Hz) 6 dB .... AUTO
TUNING/PRESET .... TUNING

b. Place the AC POWER switch to its ON position, the LED readouts for the REFERENCE LEVEL and CENTER FREQUENCY will illuminate. The REFERENCE LEVEL readout should indicate 110 dBuV. Utilize the TUNING control to set the CENTER FREQUENCY readout at 000 MHz indication.
c. Approximately 20 seconds after AC power turn on, a zero frequency trace should appear on the CRT DISPLAY. If the trace does not appear, turn the INTENSITY control clockwise. Likewise if the trace brightness is too strong, turn the INTENSITY control counterclockwise.

CAUTION

To avoid damaging the CRT, refrain from operating the CRT at full intensity for long periods of time.

d. If the trace is not sharply defined, adjust the FOCUS control.
e. If the zero frequency trace is tilted with respect to the vertical axis of CRT graticule markings, adjust the TRACE ALIGN control with a screwdriver as shown in Figure 3.4.
f. Connect the CAL OUT to the INPUT of the unit. Allow the unit to warm up in this condition for 30 minutes before proceeding with the calibration procedures.

5.7.3 CRT DRIVER Board (SG210) Adjustment

Equipment used: Digital Voltmeter

5.7.3.1 CRT BIAS VOLTAGE Adjustment

a. Connect the Digital Voltmeter to TP9 on the CRT DRIVER board.
b. Adjust R85 for +170 VDC ±1 V on the voltmeter.

5.7.3.2 FOCUS Adjustment

a. Reset the following ESA-1000 front panel controls.

CENTER FREQUENCY .... 100 MHz
SCAN MODE ....MANUAL
DISPERSION/DIV. ....ZERO
B.W. ....1.5 MHz

b. Center the resulting bright spot on the CRT by utilizing the MANUAL SCAN and FINE TUNING controls. Use the INTENSITY control to reduce the trace brightness. Adjust R86 (ASTIG) in conjunction with the front panel FOCUS control for a sharp trace.
c. Return the SCAN MODE switch to the AUTO position.

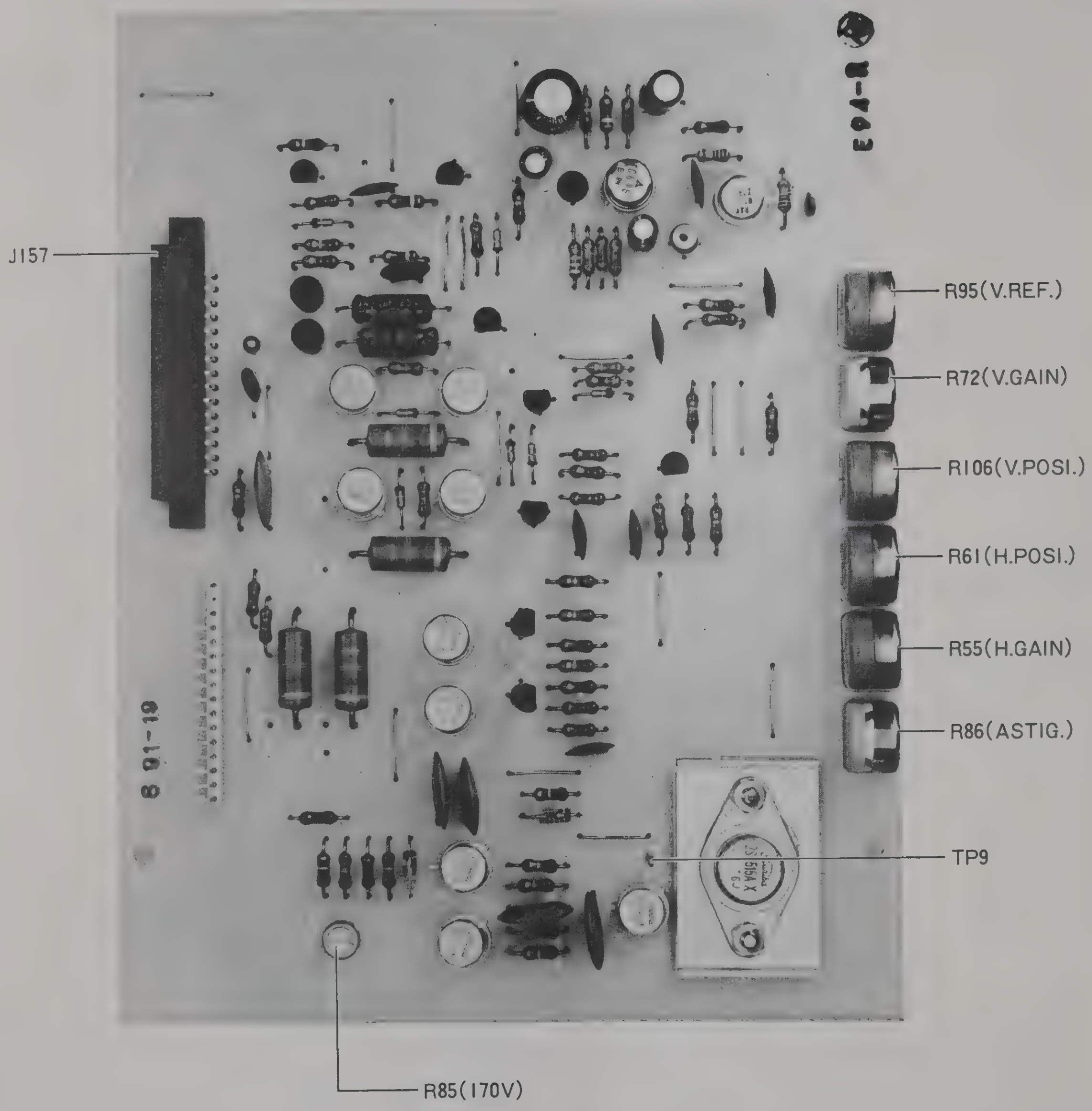


Figure 5.8 CRT DRIVER BD. (SG210)

5.7.3.3 VERTICAL AXIS Adjustment

a. Retaining the front panel control settings of Section 5.7.3.2, connect the voltmeter to Pin 2 of Connector J157. Adjust the TUNING and FINE TUNING controls for a reading of +2.0 VDC to ± 0.05 V on the voltmeter.
b. Adjust R113 (V. POSI) to set the trace at the -40 dB level on the CRT (40 dB down from the Reference point).
c. Set the outer section of the IF GAIN switch to the 30 dB position. Utilizing the FINE TUNING plus the inner section of the IF GAIN switch or adjust the voltage at Pin 2 of Connector J2 to +4.0 VDC ± 0.05 V.
d. Adjust R72 (V. GAIN) to set the trace to the 0 dB line of the CRT graticule.
e. Due to interaction between adjustments, repeat steps a-d until no further readjustments are necessary.

5.7.3.4 VERTICAL REFERENCE LEVEL Adjustment

a. Repeat the procedure of 5.7.3.3.-c to set the voltage on Connector J2-2 to +40 VDC ±0.05 V.
b. Reset the Vertical Axis Scale Selector switch to the 5 dB/DIV. position. Adjust R95 (U. REF) to set the trace to the top horizontal line of the graticule.

5.7.3.5 HORIZONTAL AXIS Adjustment

a. Reset the front panel controls to the initial settings of Section 5.7.2.2-a modified as per Section 5.7.3.2-a. Adjust the IF GAIN and RF ATTENUATOR switches to set the trace at the -40 dB level on the CRT.
b. Connect the voltmeter to Pin 14 of Connector J157 and set the SCAN MODE switch to the MANUAL position. Adjust the MANUAL SCAN control to set the voltage on Pin 14 to 0.00 VDC.
c. Adjust R61 (H. POSI) to position the bright dot at the center of the CRT.
d. Adjust the MANUAL SCAN to set the voltage on Pin 14 to -4.5 VDC ±0.1 V.
e. Adjust R55 (H. GAIN) to set the bright spot on the left side vertical end line.
f. Due to interaction between adjustments, repeat steps c-e until no further readjustments are necessary.

5.7.3.6 BASELINE Adjustment

a. Disconnect the CAL OUT from the unit's INPUT and reset the front panel controls as follows:

VERTICAL AXIS SCALE
SELECTOR .... 10 dB/DIV.
IF GAIN .... 0 dB, CAL.
B.W. .... AUTO

b. Adjust R113 (V. POSI) to set the trace baseline to the CRT graticule bottom line.

5.7.4 CAL. OSC. BOARD (SF145) Adjustment

Equipment used: High Frequency Power Meter (50 r)
Frequency Counter
Signal Generator

5.7.4.1 OUTPUT LEVEL Adjustment

a. Connect the power meter to the CAL OUT of the instrument to measure the CAL OUT output level.
b. Adjust R16 of the CAL OSC. board to set the output level at -27 dBμ.

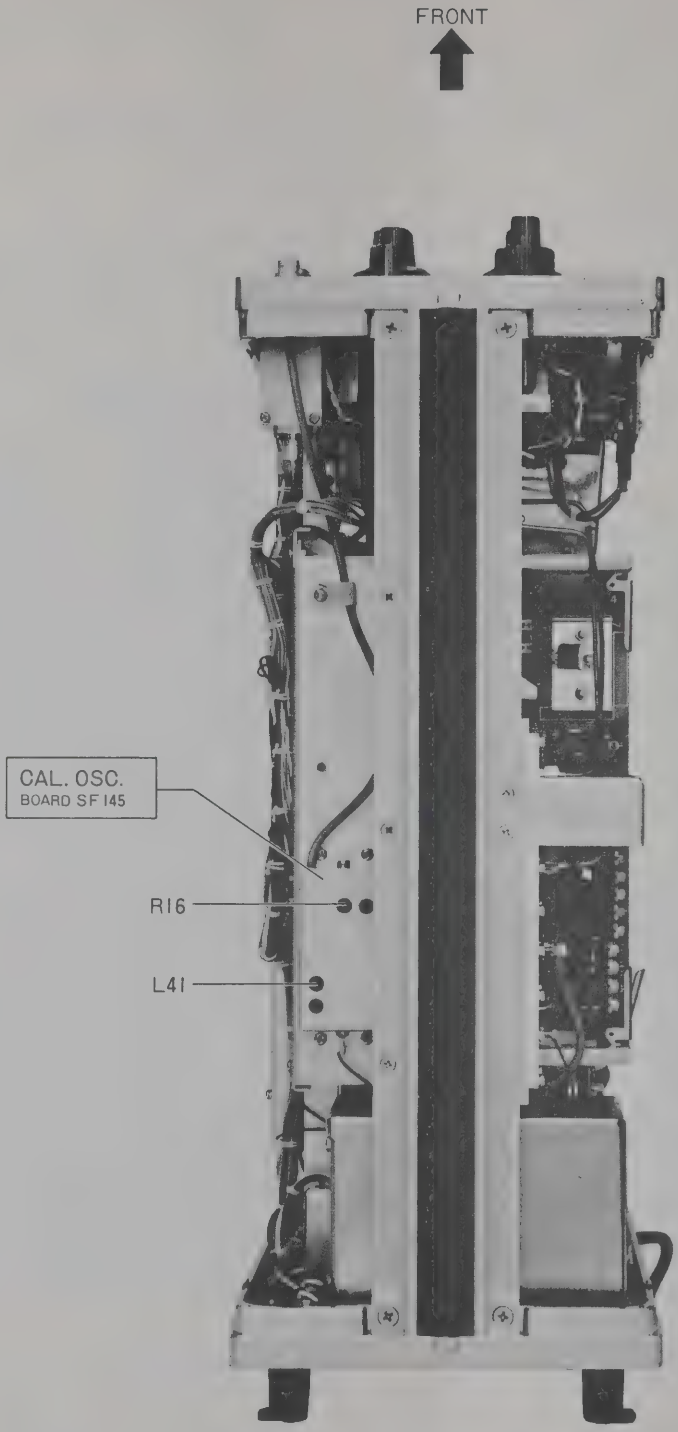
5.7.4.2 OUTPUT FREQUENCY Adjustment

a. Set the output of the Signal Generator to 100,000 MHz.
b. Connect the output of the Signal Generator to the INPUT of the instrument and set the output level at 80 dBuV. Set the ESA-1000 front panel DISPERSION/DIV. switch to the 0.1 MHz/DIV. position.
c. Utilize the TUNING control to center the signal on the CRT.
d. Disconnect the Signal Generator output from the unit and connect the CAL OUT to the INPUT. Adjust L41 on the CAL OSC. board to position the signal within ±1.0 divisions of the center line.

5.7.5 LOG AMP BOARD (PH209) Adjustment

Equipment used: Signal Generator
10 dB Step Attenuator

a. Remove the L shaped metal bracket supporting the PF103 and PH209 boards and



Note: Remove the connector plate for DM-1000 to adjust those controls.
The connector plate is installed by the two screws on its side.

Figure 5.9 Location of CAL. OSC. Adjustment

remove the PH209 board. Insert the PH209 board into an extender board and re-insert combination into the unit.

b. Reset the following front panel controls from their initial settings of Section 5.7.2.2.

DETECTION MODE .... MEAN
VIDEO FILTER .... 10 kHz

c. As shown in Figure 5.10, disconnect connector J53 from the output of the SK030 board which is the input of the 1 dB step IF Attenuator (MEP-263). Utilizing the UM—UM Adapter (UM-QA-JJ), connect the Signal Generator output (3.33 MHz at +6.0 dBμ) to J53 via the external 10 dB step attenuator.

5.7.5.1 LOG ADJUSTMENT

a. With the test setup given, set the external 10 dB step attenuator to the 0 dB position.
b. Adjust R150 (LOG GAIN) on the LOG AMP board to set the trace on the CRT to the 0 dB level (top horizontal line).
c. Set the external 10 dB step attenuator to the 60 dB position. Adjust R163 (LOG OFFSET) on the LOG AMP board to set the trace on the CRT to the -60 dB level (third horizontal line from CRT bottom).
d. Due to interaction between adjustments, repeat steps b-c until no further readjustments are necessary.

5.7.5.2 LINEAR Adjustment

a. Set the external 10 dB step attenuator to the 40 dB position and the Vertical Axis Scale Selector switch to the LINEAR position.
b. Adjust R176 (LIN. GAIN) on the LOG AMP board to set the trace on the CRT to the 0 dB level (top horizontal line).

5.7.5.3 Q.P. Adjustment

a. Set the external 10 dB step attenuator to the 40 dB position and the Vertical Axis Scale Selector switch to the 10 dB/DIV. position.
b. Set the ESA-1000 DETECTION MODE to the Q.P. position. Adjust R297 (QP3) on

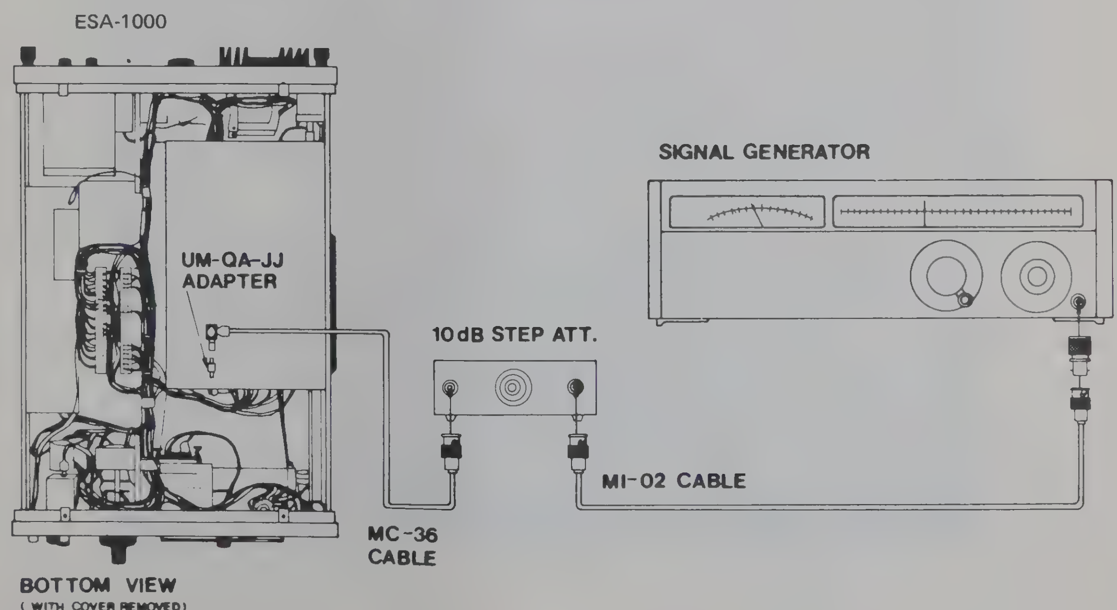


Figure 5.10 LOG. AMP. Adjustment Setup

the LOG AMP board to set the trace on the CRT to the 0 dB level (top horizontal line).

c. Reset the external 10 dB step attenuator to the 70 dB position. Adjust R293 (QP1) on the LOG AMP board to set the trace on the CRT to the -30 dB level.

d. Reset the external 10 dB step attenuator to the 80 dB position. Adjust R288 (QP2) on the LOG AMP board to set the trace on the CRT to the -40 dB level.

e. Due to interaction between adjustments, repeat steps c-d until no further readjustments are necessary.

5.7.6 RAMP GENERATOR, YIG DRIVER, AND DISPLAY CONTROL Adjustment

Equipment used: Digital Voltmeter

5.7.6.1 10 VDC Adjustment

a. Connect the Digital Voltmeter to TP1 on the Ramp Generator and YIG Driver board (PF130). Adjust R91 (10 V) for a reading of 10.00 VDC ± 0.005 V on the voltmeter.

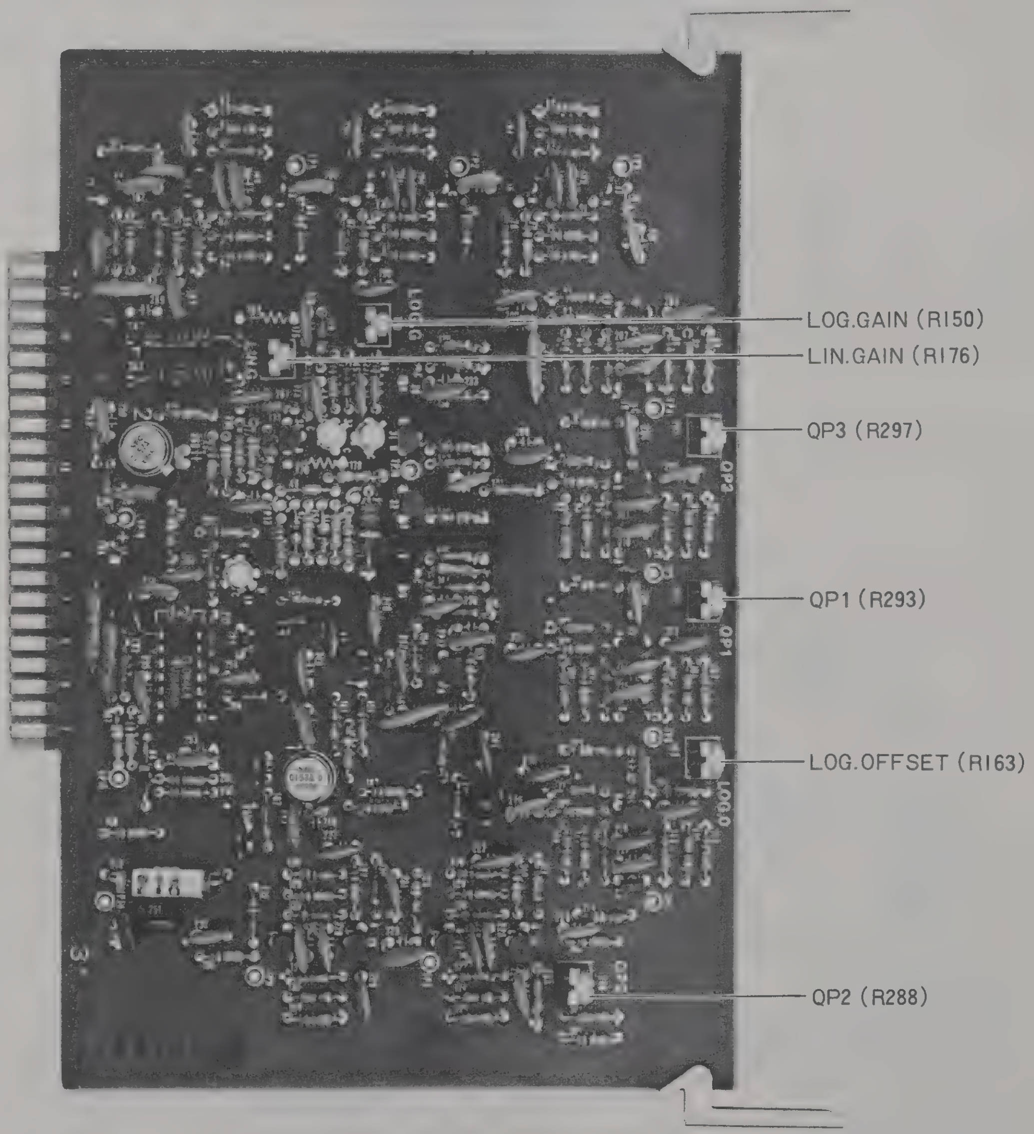


Figure 5.11 LOG AMP Board (PH209)

5.7.6.2 DISPERSION Adjustment

a. Reset the following front panel controls from the initial setting of Section 5.7.2.2:

CENTER FREQUENCY .... 500 MHz
SCAN TIME .... White line at 12 o'clock

b. Adjust R48 (DISP.) on the R.G. and YIG Driver board, while adjusting the front panel TUNING control to set the zero frequency trace to the left hand vertical end line and the 10th harmonic (1000 MHz) signal to the right hand vertical end line with the CAL OUT signal applied to the INPUT.

5.7.6.3 VARIABLE WIDTH Adjustment

a. Again with the CAL OUT signal applied to the INPUT, turn the TUNING control fully counterclockwise. Adjust R84 (LO.F) of the R.G. and YIG Driver board to set the zero frequency trace to the 4th vertical line from the right on the CRT (Figure 5.13A).

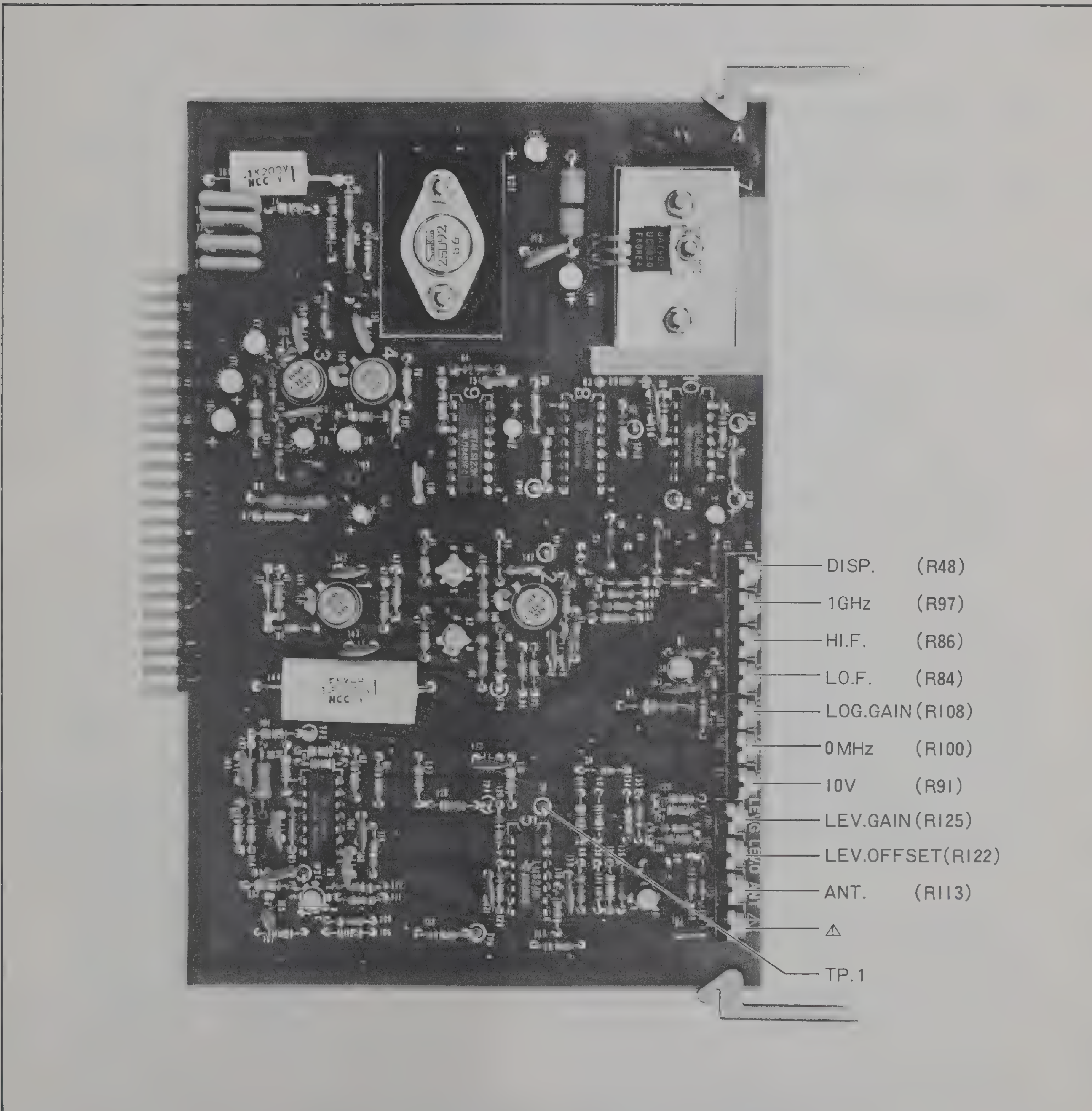


Figure 5.12 Ramp Generator & YIG Driver Board (PF130)

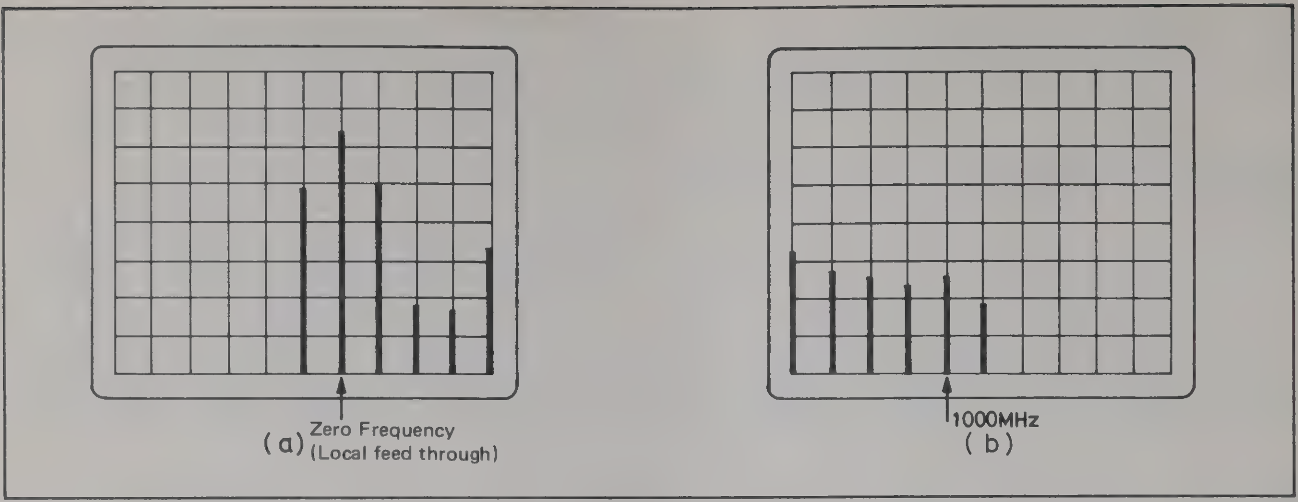


Figure 5.13 Variable Width Adjustment Display

b. Turn the TUNING control fully clockwise and adjust R86 (HI.F) of the R.G. and YIG Driver board to set the 10th harmonic signal (1000 MHz) to the 4th vertical line from the left on the CRT (Figure 5.13B).

5.7.6.4 FREQUENCY DISPLAY Adjustment

a. Adjust the front panel TUNING control to set the zero frequency trace at the center of the CRT DISPLAY. Set the DISPERSION/DIV. switch to the 5 MHz/DIV. position. Again use the TUNING control to center the zero frequency trace.
b. Adjust R100 (0 MHz) of the R.G. and YIG Driver board for a reading of 000 MHz on the CENTER FREQUENCY readout.
c. Adjust the TUNING control to set the 10th harmonic (1000 MHz) of the CAL. OUT signal at the center of the CRT DISPLAY.
d. Adjust R97 (1 GHz) of the R.G. and YIG Driver board for a reading of 1000 MHz on the CENTER FREQUENCY readout.

5.7.6.5 ANTENNA COEFFICIENT COMPENSATION Adjustment

a. Adjust the TUNING control for a reading of 34 MHz on the CENTER FREQUENCY readout.
b. Reset the REFERENCE LEVEL switch from INPUT LEVEL to the ANTENNA-A position. Adjust R113 (ANT.) of the R.G. and YIG Driver board to keep the reading on the REFERENCE LEVEL readout unchanged.
c. Adjust the TUNING control for a reading of 1000 MHz on the CENTER FREQUENCY readout.
d. Adjust R108 (LOG G.) of the R.G. and YIG Driver board so that the reading on the REFERENCE LEVEL readout increases by a value of 31 dB when switching between INPUT LEVEL and ANTENNA A.
c. Adjust R110 (Δ) of the R.G. and YIG Driver board so that the reading on the REFERENCE LEVEL readout decreases by a value of 5 dB when switching between ANTENNA-A and ANTENNA-B.

TABLE 5.2 Level Display Adjustment Settings

IF GAIN	RF. ATT.	LED Display
30 dB	0 dB	80 dBμ
20 dB	0 dB	90 dBμ
10 dB	0 dB	100 dBμ
0 dB	0 dB	110 dBμ
0 dB	10 dB	120 dBμ
0 dB	20 dB	130 dBμ
0 dB	30 dB	140 dBμ
0 dB	40 dB	150 dBμ

5.7.6.6 LEVEL DISPLAY Adjustment

a. Set the inner switch of the IF GAIN switch to the CAL position. Adjust R125 (LEV. G) and R122 (LEV. O) of the R.G. and YIG Driver board so that the REFERENCE LEVEL readout displays the values shown

for the combined IF GAIN and RF ATTENUATOR switch settings shown in Table 5.2

5.7.7 IF FILTER Adjustment

Equipment used: Spectrum Analyzer (Optional)

NOTE: The Spectrum Analyzer is utilized only for Section 5.7.7.1 of the following procedure. If a Spectrum Analyzer or other suitable equipment is not available, the remaining sections of the procedure can be performed as described since Section 5.7.7.1 has no effect on the other procedures.

5.7.7.1 3rd LOCAL OSCILLATOR Adjustment (Optional)

a. Remove the cover over the IF FILTER board (SK030) and loosely couple by L307 to the Spectrum Analyzer (Figure 5.14). Adjust L307 so that the 3rd Local Oscillator frequency read by the Spectrum Analyzer is 43.3 MHz ± 1 MHz. If problems are suspected with the 3rd Local Oscillator, return the unit to the factory for repair.

NOTE: The 3rd Local Oscillator has a very stable output frequency, no adjustments are normally required.

5.7.7.2 300 kHz to 9 kHz BAND PASS FILTER Adjustment

a. Connect the CAL OUT signal to the INPUT and reset the following front panel controls from the initial settings of 5.7.2.2.

CENTER FREQUENCY .... 100 MHz
SCAN TIME .... 11 o'clock
VERTICAL AXIS SCALE SELECTOR .... 5 dB/DIV.
IF GAIN .... 10 dB
DISPERSION/DIV. .... 0.1 MHz/DIV.
B.W. .... 9 kHz

b. Use the TUNING and FINE TUNING controls to center the 100 MHz CAL signal on the CRT.
c. Adjust C284 of the IF Filter board (see Figure 5.15) to null the signal to its lowest point (Figure 5.16).
d. Adjust C225, C235, C256, and C268 of the IF FILTER board to peak the signal to its highest level.
e. Due to interactions between adjustments, repeat steps c-d until no further readjustments are necessary.

5.7.7.3 BANDWIDTH SWITCHING LEVEL ERROR Adjustment

a. Reset the BANDWIDTH switch to the AUTO position and the DISPERSION/DIV. switch to the 100 MHz/DIV. position.

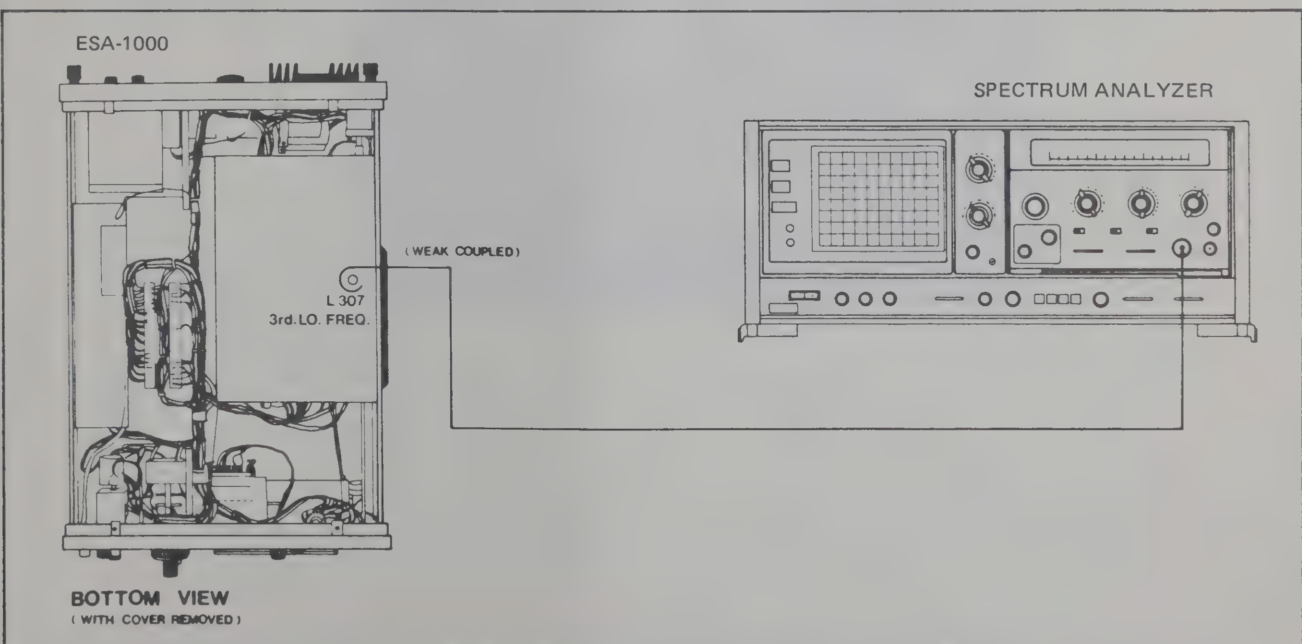


Figure 5.14 IF FILTER Adjustment Setup (Optional)

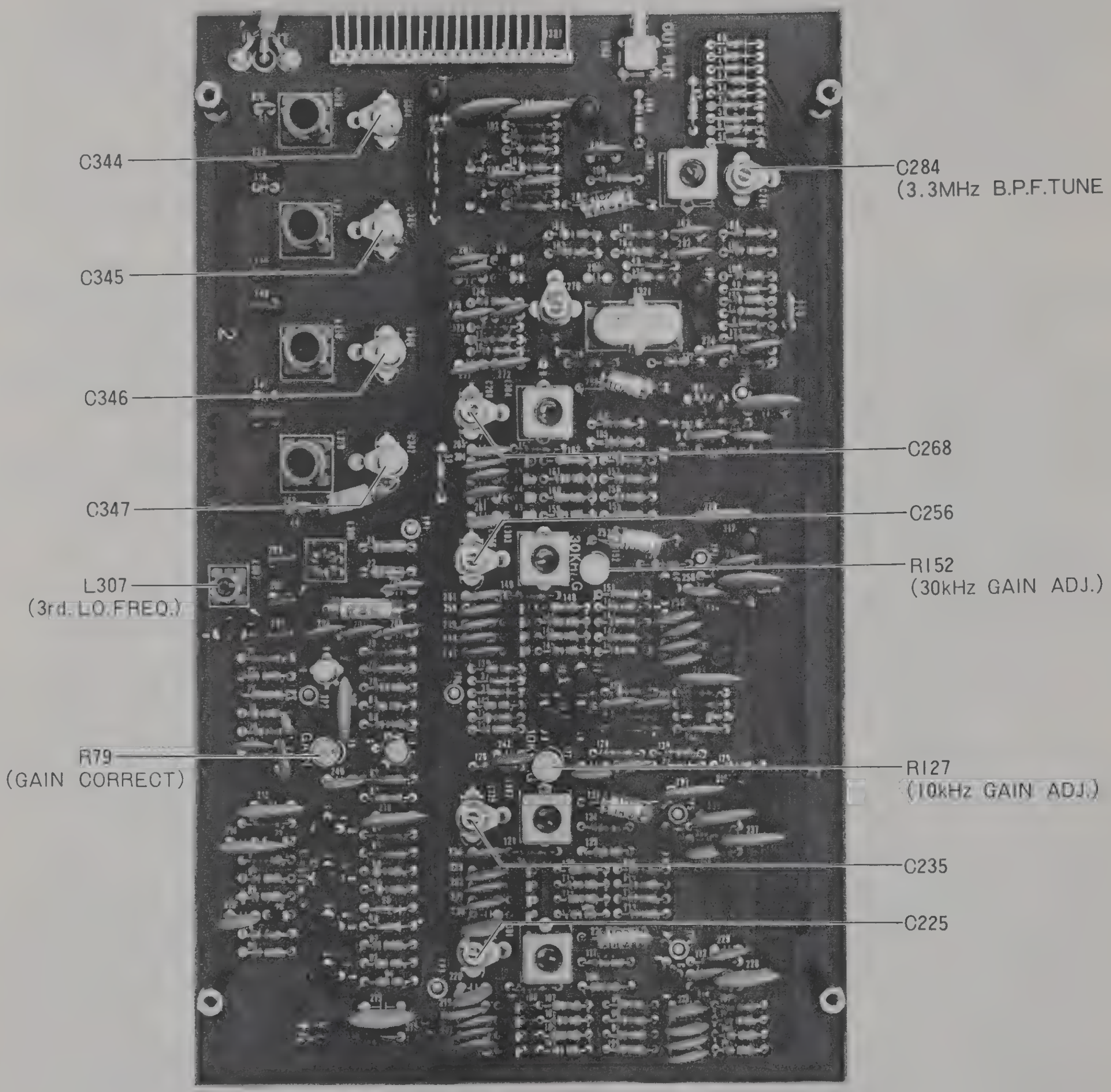


Figure 5.15 IF FILTER BD. (SK030) Adjustments

b. Adjust the outer and inner sections of the IF GAIN switch to set the 100 MHz CAL signal peak at the center of the CRT.
c. Adjust R152 (30 kHz GAIN ADJ.) of the IF FILTER board to center the signal peak on the CRT when the DISPERSION/DIV. switch is set to the 2 MHz/DIV. position.
d. Also adjust R127 (10 kHz GAIN ADJ.) to center the signal peak when the DISPERSION/DIV. switch is set to the 0.2 MHz/DIV. position.
e. Due to interactions between adjustments, repeat steps c-d until no further readjustments are necessary.

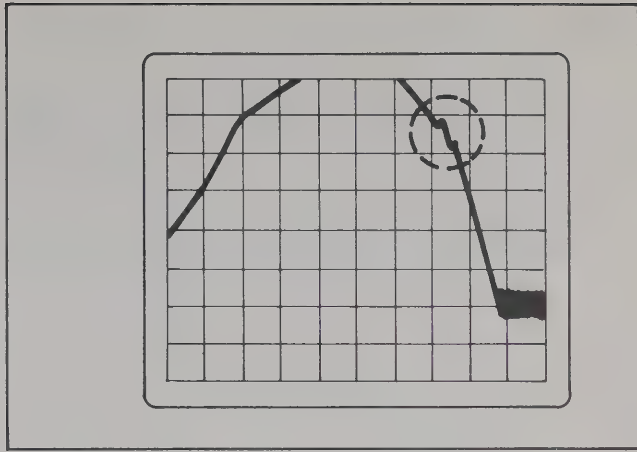


Figure 5.17 1.5 MHz B.P.F. example

5.7.7.4 1.5 MHz BANDWIDTH Adjustment

Equipment used: Signal Generator

a. Reset the following front panel controls from the initial settings of Section 5.7.2.2.

CENTER FREQUENCY .... 100 MHz
DISPERSION/DIV. .... 0.5 MHz/DIV.
B.W. ....1.5 MHz
RF. ATT. (dB) ....0 dB

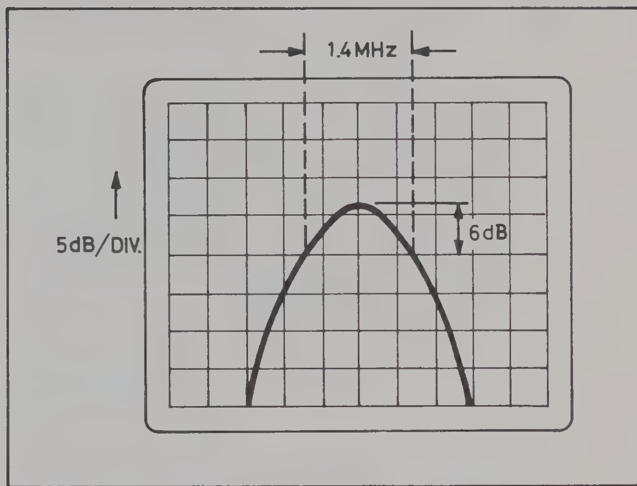


Figure 5.18 B.W. 1.5 MHz

b. Connect the Signal Generator output (100 MHz at +10 dBμ) to the INPUT of the instrument.
c. Set the outer section of the IF GAIN switch to the +30 dB position and carefully observe the CRT DISPLAY. If the upper section of the signal curve has become irregular (see Figure 5.17), adjust C344 to C347 of the IF FILTER board.
d. Set the Vertical Axis Scale Selector switch to the 5 dB/DIV. position and adjust the outer and inner sections of the IF GAIN switch so that the bandwidth 6 dB below the signal peak can be clearly observed.
e. Reset the outer section of the IF GAIN switch to the 0 dB position and adjust C344 to C347 of the IF FILTER board so that the bandwidth 6 dB below the signal peak is 1.5 MHz ± 0.3 MHz.

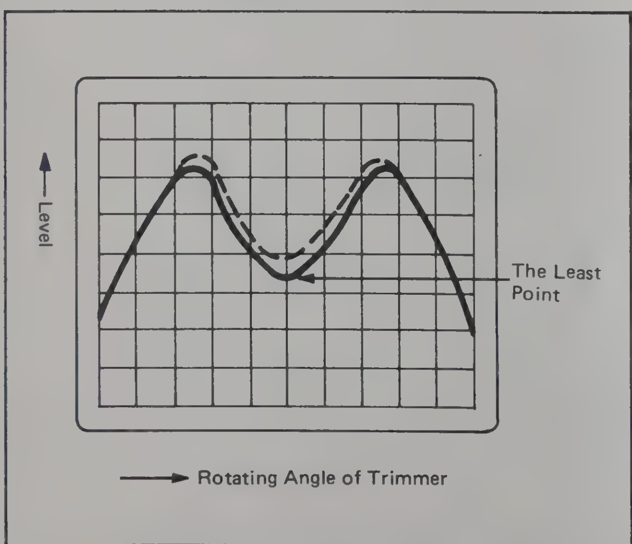


Figure 5.16 B.P.F. Adjustment Display

5.7.7.5 OVERALL GAIN Adjustment

a. Reset the following front panel controls from the initial settings of Section 5.7.2.2.

DISPERSION/DIV. ....100 MHz/DIV.
B.W. .... AUTO
IF GAIN ....0dB, CAL. REFERENCE
R.F. ATT. ....0dB LEVEL 110dBμ

b. Connect the CAL OUT 100 MHz signal to the INPUT of the instrument.
c. Set the IF GAIN inner and outer switches at the center of their adjustment ranges (e.g. inner switch to CAL and outer switch to +20 dB).
d. Adjust R79 (GAIN CORRECT) on the IF FILTER board to set the peak of the signal to the 3rd horizontal line from the top.

5.7.8 RF BLOCK CHECK (Optional)

Equipment used: Spectrum Analyzer
Signal Generator

NOTE: This procedure is optional, no adjustments are performed. It is intended only to verify the operational status of the RF BLOCK. In most cases, if fault is suspected in the RF BLOCK it is recommended that the instrument be returned to the factory for repair.

5.7.8.1 2nd LOCAL FREQUENCY CHECK

a. Connect the Spectrum Analyzer to the 2nd LO OUTPUT (J46) and verify that the 2nd LO frequency is 1200 MHz ± 3 MHz (Figure 5.19).
b. Disconnect the Spectrum Analyzer and reconnect the 2nd LO cable to (J46).

5.7.8.2 1153.3 MHz BAND PASS FILTER CHECK

a. Connect the Signal Generator output (46.6 MHz at −30 dBμ) to the INPUT of the instrument.
b. Reset the DISPERSION/DIV. switch to the 0.5 MHz/DIV. position and utilize the TUNING control to center the signal on the CRT display.
c. Reconnect the Spectrum Analyzer to the 2nd LO output (J46). The signal on the Spectrum Analyzer will shift as shown in Figure 5.19A. This is the frequency passing characteristics of the 1153.3 MHz Band

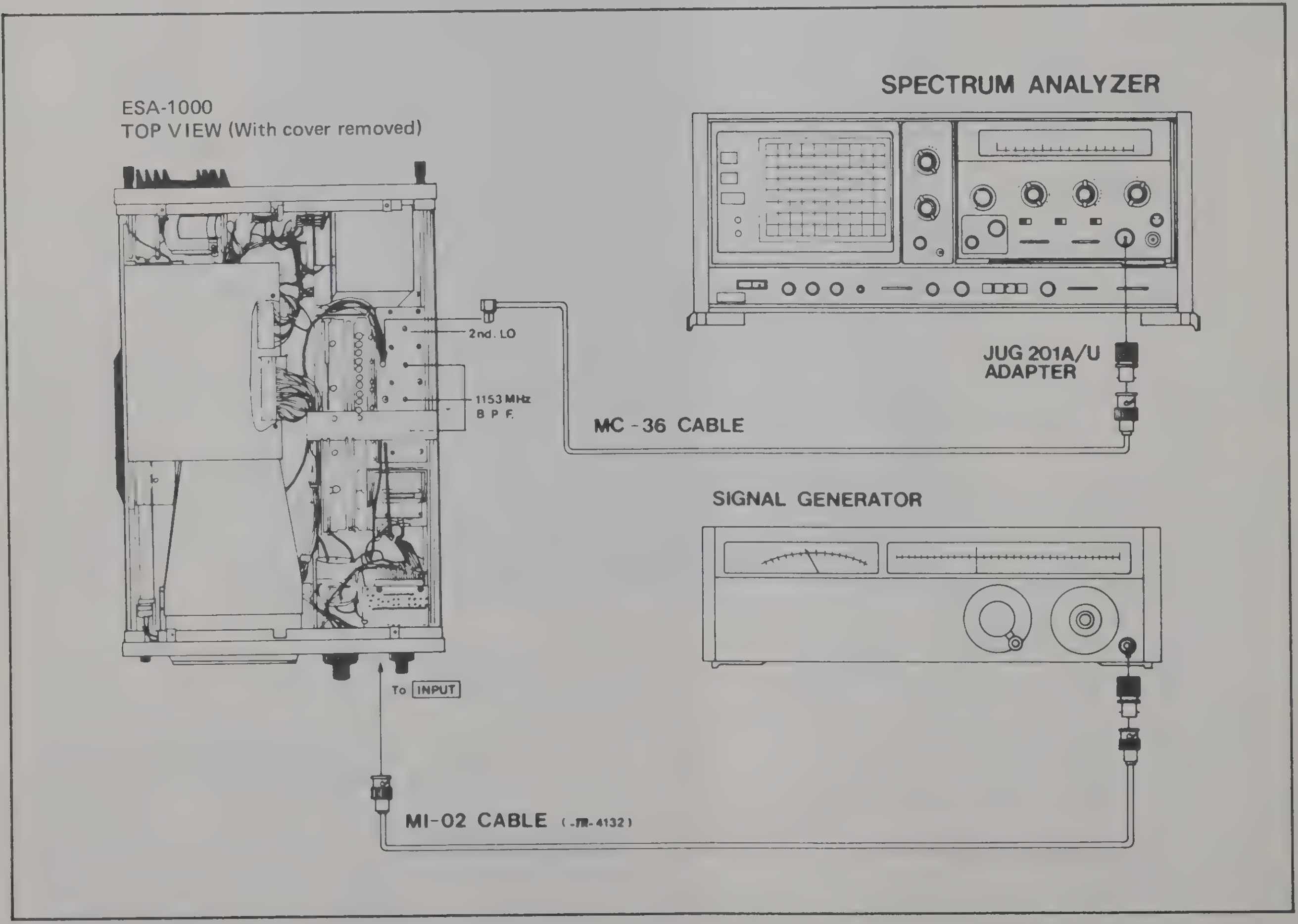


Figure 5.19 RF. Block Check Setup (Optional)

Pass Filter. For easier observation of this signal, set the ESA-1000 SCAN TIME to a slower sweep speed.

d. Set the DISPERSION/DIV. switch of the Spectrum Analyzer to 1 MHz/DIV. and its Vertical Axis Scale Selector switch to 2 dB/DIV. Verify with the Spectrum Analyzer that the bandwidth at 6 dB below the signal peak is more than 2.6 MHz and that the signal is symmetrical from the center point (Figure 5.19B).

e. Reset the DISPERSION/DIV. switch of the ESA-1000 to the ZERO position and center the signal on the Spectrum Analyzer CRT display by use of its TUNING control.

f. Verify that the amplitude level output of the 2nd LO (J46) is between -29 dBμ and -31 dBμ.

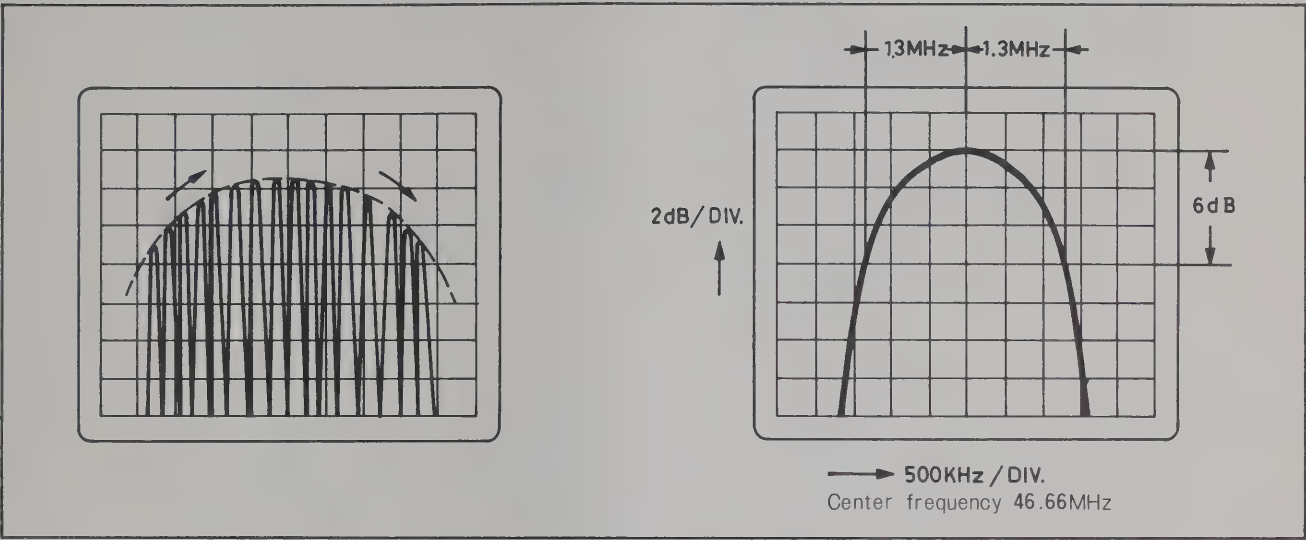


Figure 5.20 B.P.F. Check Display

NOTE: The loss through the RF Block is measured by applying a 46.66 MHz external signal to the RF input of the RF Block. By simultaneously measuring the input 46.66 MHz signal and the resultant 46.66 MHz IF output with a spectrum analyzer, the overall loss of the RF Block is made known.

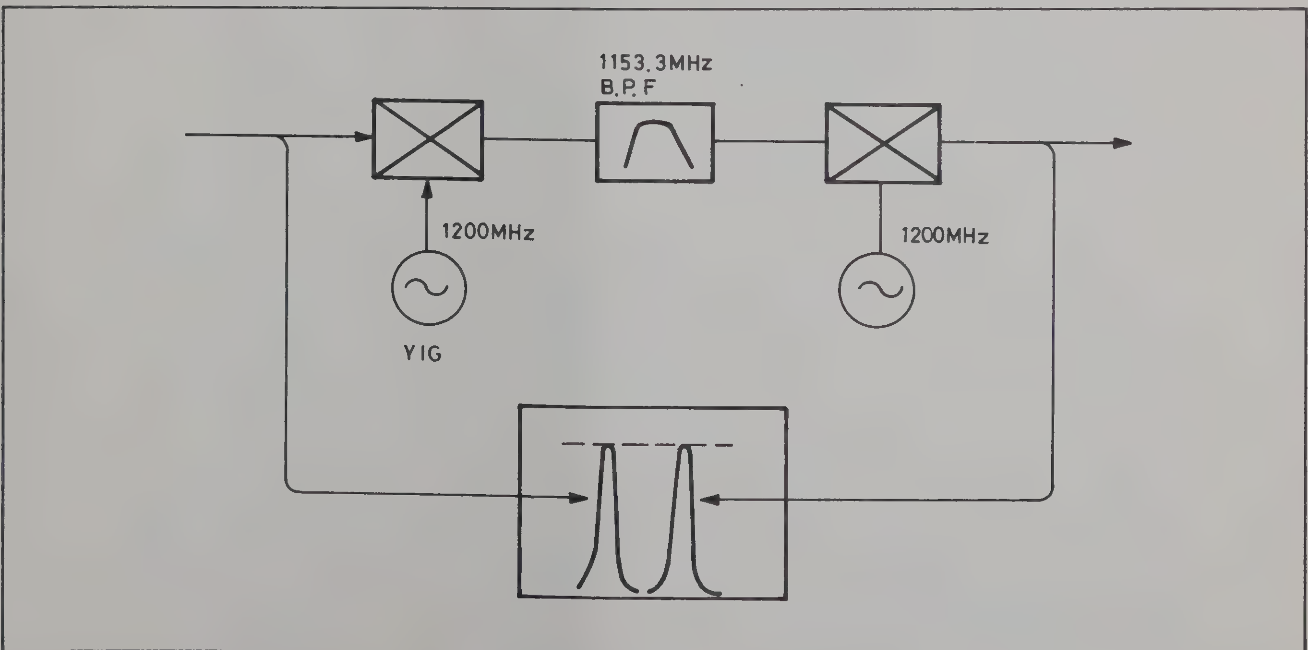


Figure 5.21 RF. BLOCK Loss Measurement

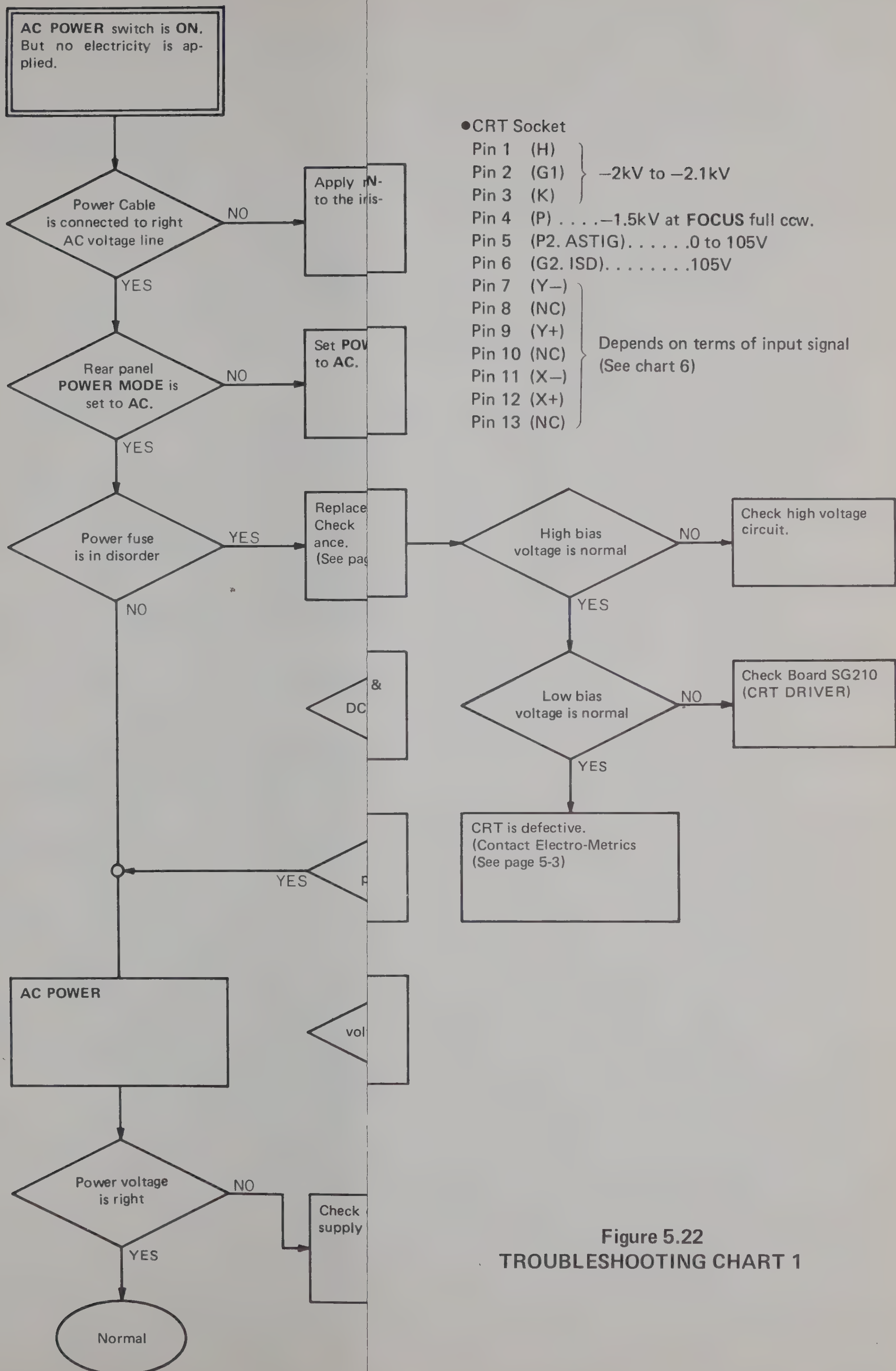
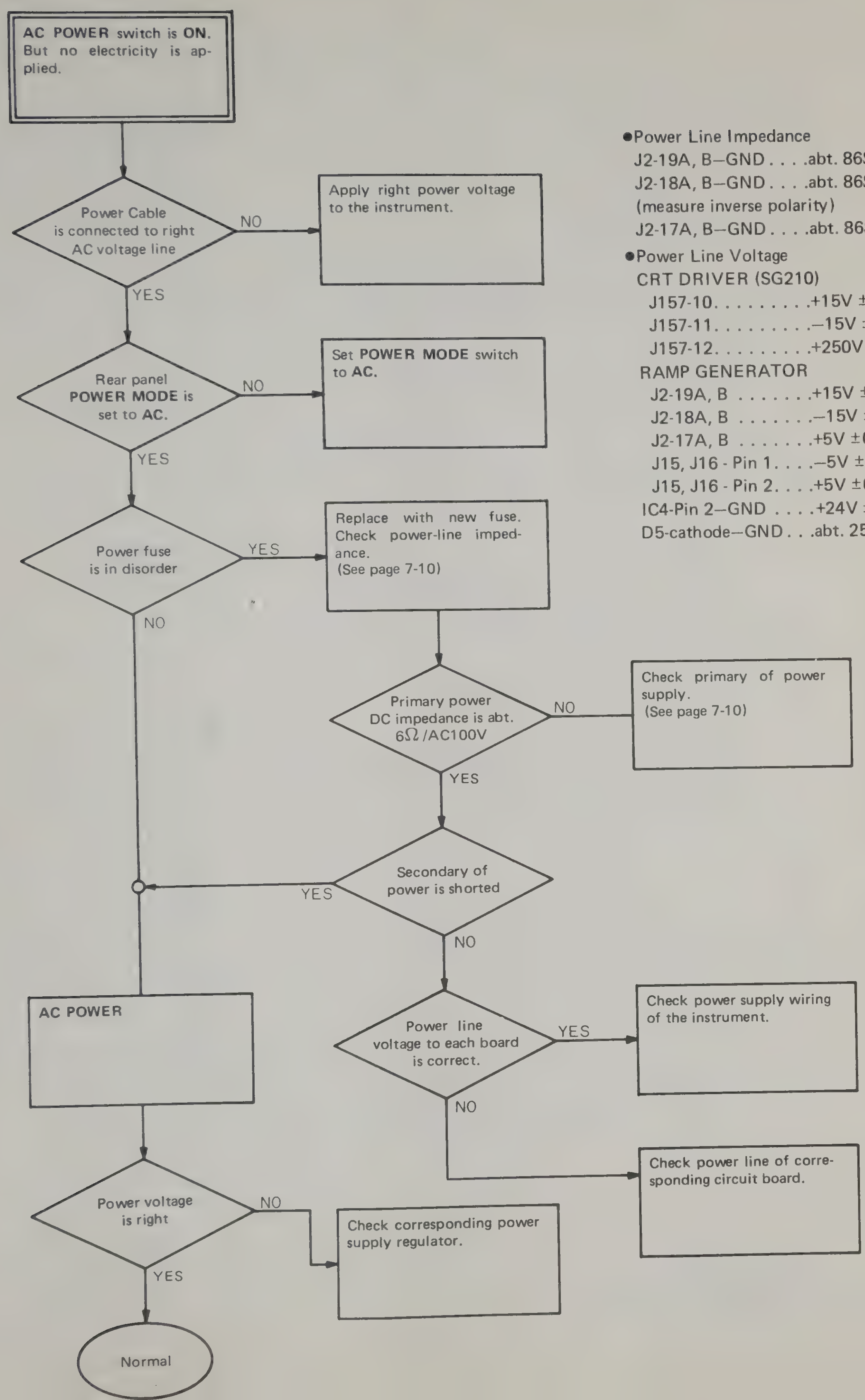
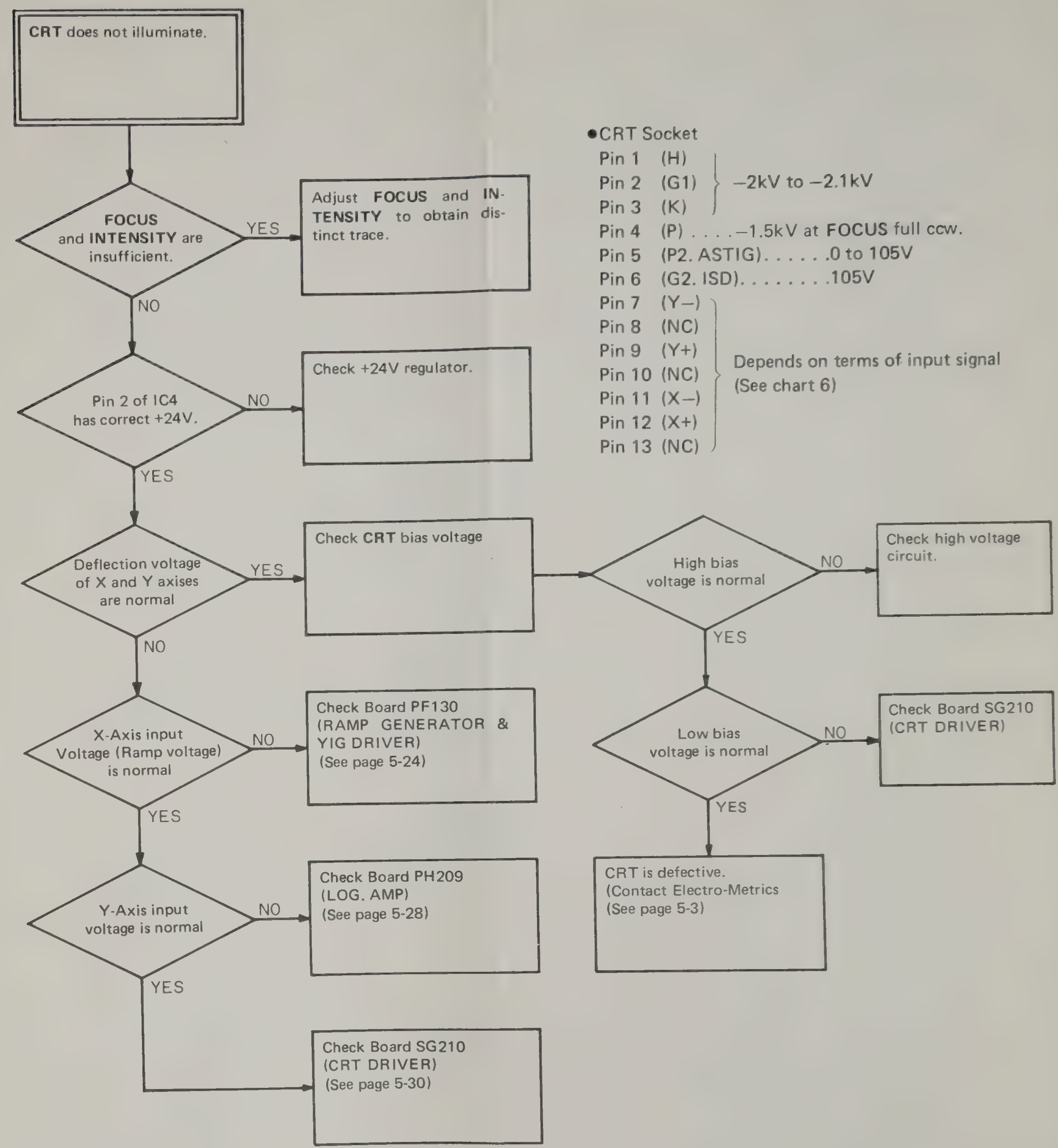


Figure 5.22
TROUBLESHOOTING CHART 1



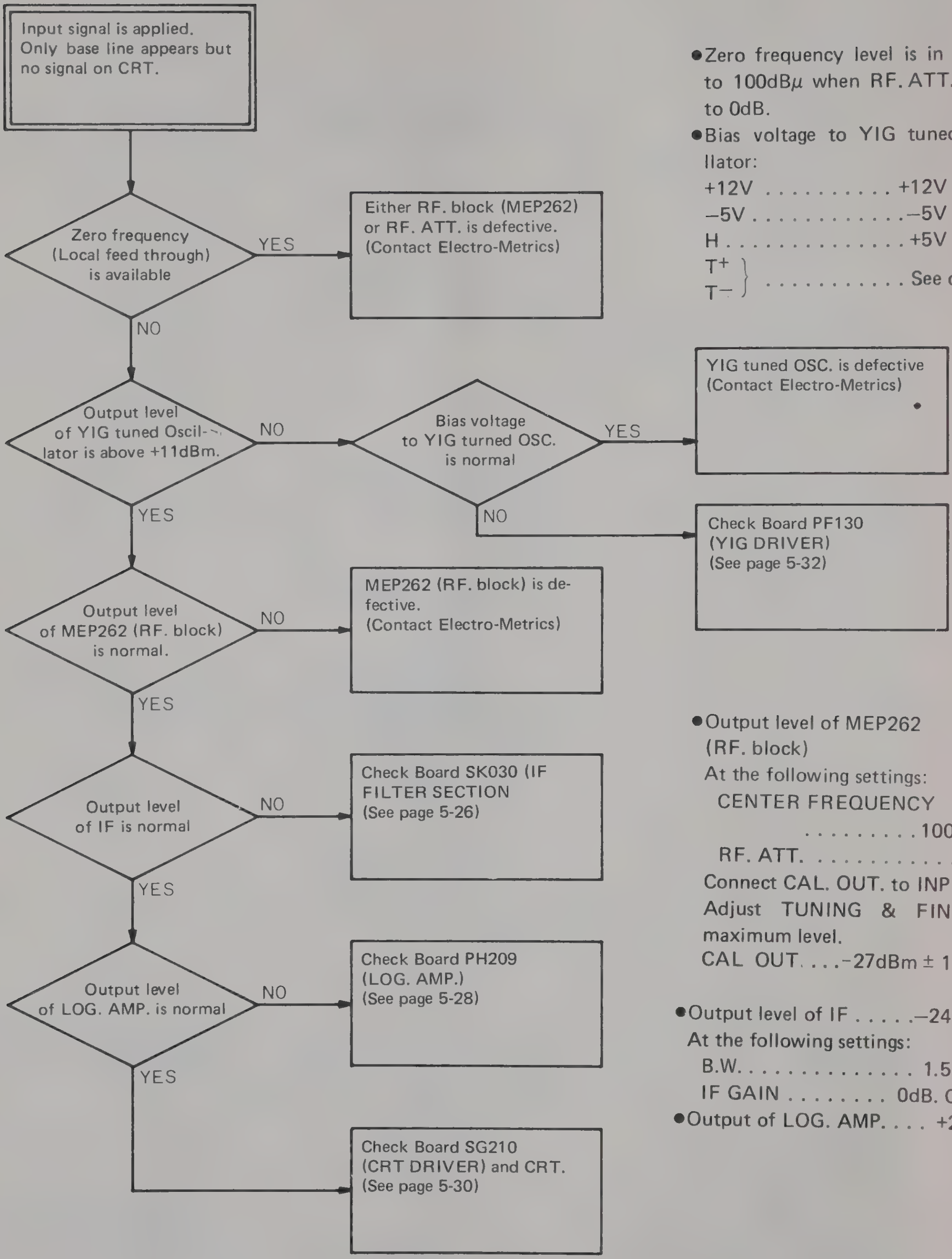
●Power Line Impedance
J2-19A, B–GND . . . .abt. 86Ω to 88Ω
J2-18A, B–GND . . . .abt. 86Ω to 88Ω
(measure inverse polarity)
J2-17A, B–GND . . . .abt. 86Ω to 88Ω

●Power Line Voltage
CRT DRIVER (SG210)
J157-10. . . . .+15V ±0.6V
J157-11. . . . .–15V ±0.6V
J157-12. . . . .+250V
RAMP GENERATOR
J2-19A, B . . . .+15V ±0.6V
J2-18A, B . . . .–15V ±0.6V
J2-17A, B . . . .+5V ±0.2V
J15, J16 - Pin 1. . . .–5V ±0.2V
J15, J16 - Pin 2. . . .+5V ±0.2V
IC4-Pin 2–GND . . . .+24V ±1.2V
D5-cathode–GND . . .abt. 250V



●CRT Socket
Pin 1 (H) }
Pin 2 (G1) } –2kV to –2.1kV
Pin 3 (K) }
Pin 4 (P) . . . .–1.5kV at FOCUS full ccw.
Pin 5 (P2. ASTIG). . . . . .0 to 105V
Pin 6 (G2. ISD). 105V
Pin 7 (Y–) }
Pin 8 (NC) }
Pin 9 (Y+) }
Pin 10 (NC) } Depends on terms of input signal (See chart 6)
Pin 11 (X–) }
Pin 12 (X+) }
Pin 13 (NC) }

Figure 5.22
TROUBLESHOOTING CHART 1



- Zero frequency level is in 90dBμ to 100dBμ when RF. ATT. is set to 0dB.
- Bias voltage to YIG tuned oscillator:
  +12V . . . . +12V ±0.6V
  –5V . . . . –5V ± 0.2V
  H . . . . +5V ±0.6V
  T+ } T– } . . . . See chart 3

- Output level of MEP262 (RF. block)
  At the following settings:
  CENTER FREQUENCY 100MHz
  RF. ATT. 0dB
  Connect CAL. OUT. to INPUT.
  Adjust TUNING & FINE for maximum level.
  CAL OUT. . . . –27dBm ± 1dBm

- Output level of IF . . . . . –24dBm
  At the following settings:
  B.W. 1.5MHz
  IF GAIN . . . . 0dB. CAL.
- Output of LOG. AMP. . . . . +2.5V

Figure 5.23
TROUBLESHOOTING CHART 2

BOARD PF130 – RAMP GENERATOR & YIG DRIVER

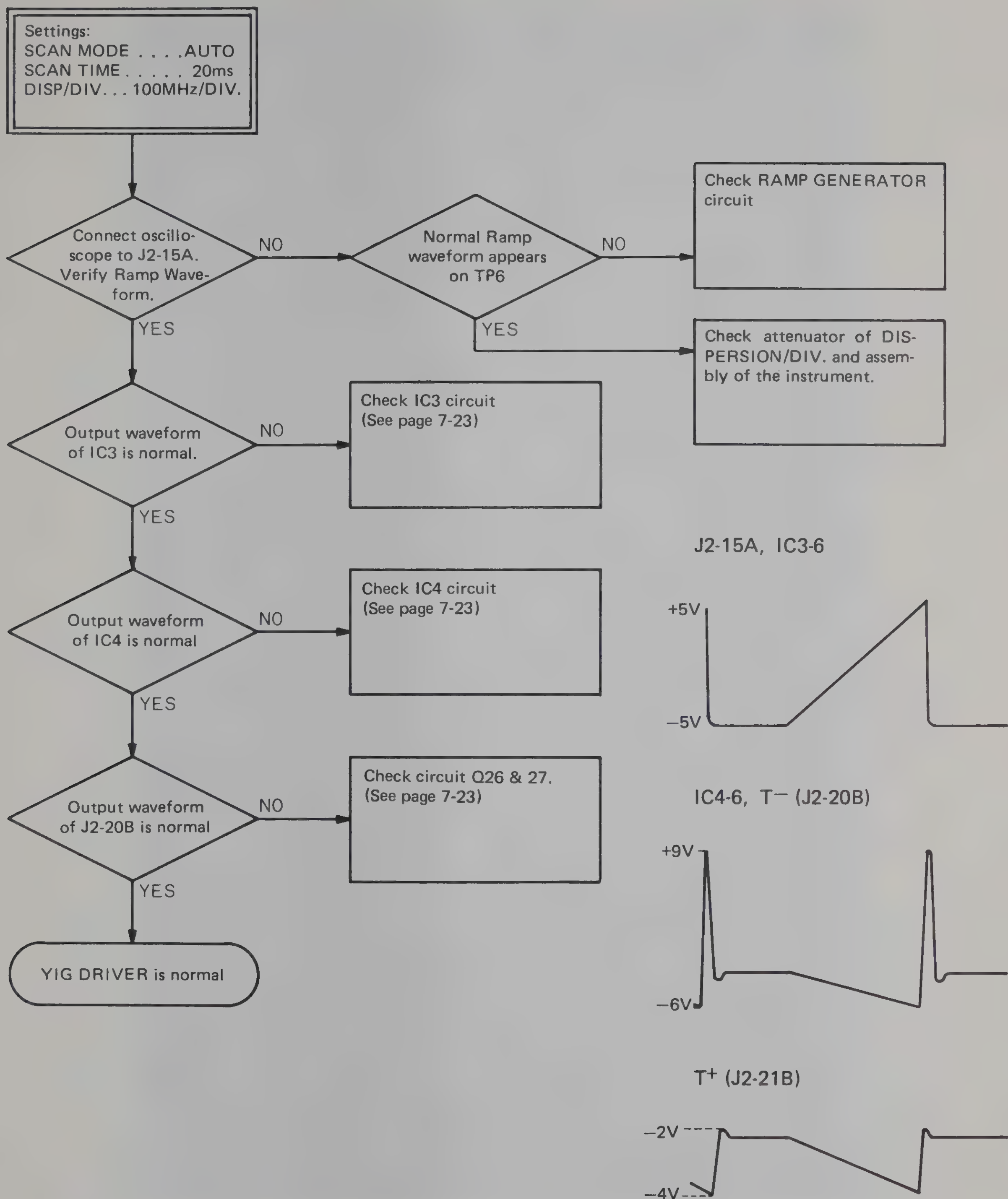


Figure 5.24
TROUBLESHOOTING CHART 3

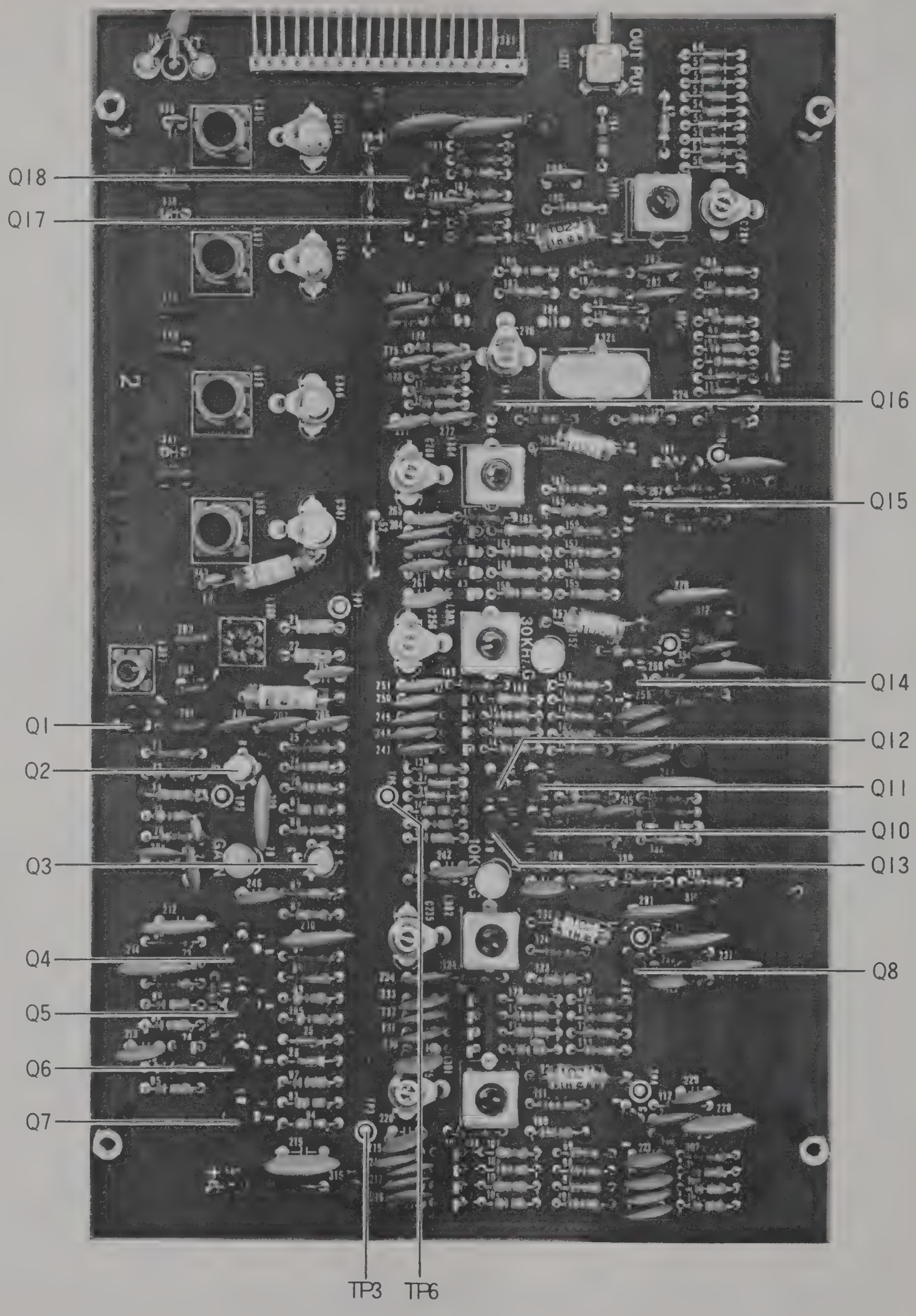


Figure 5.25 IF FILTER (SK030) CHECK POINTS

BOARD SK030 IF FILTER

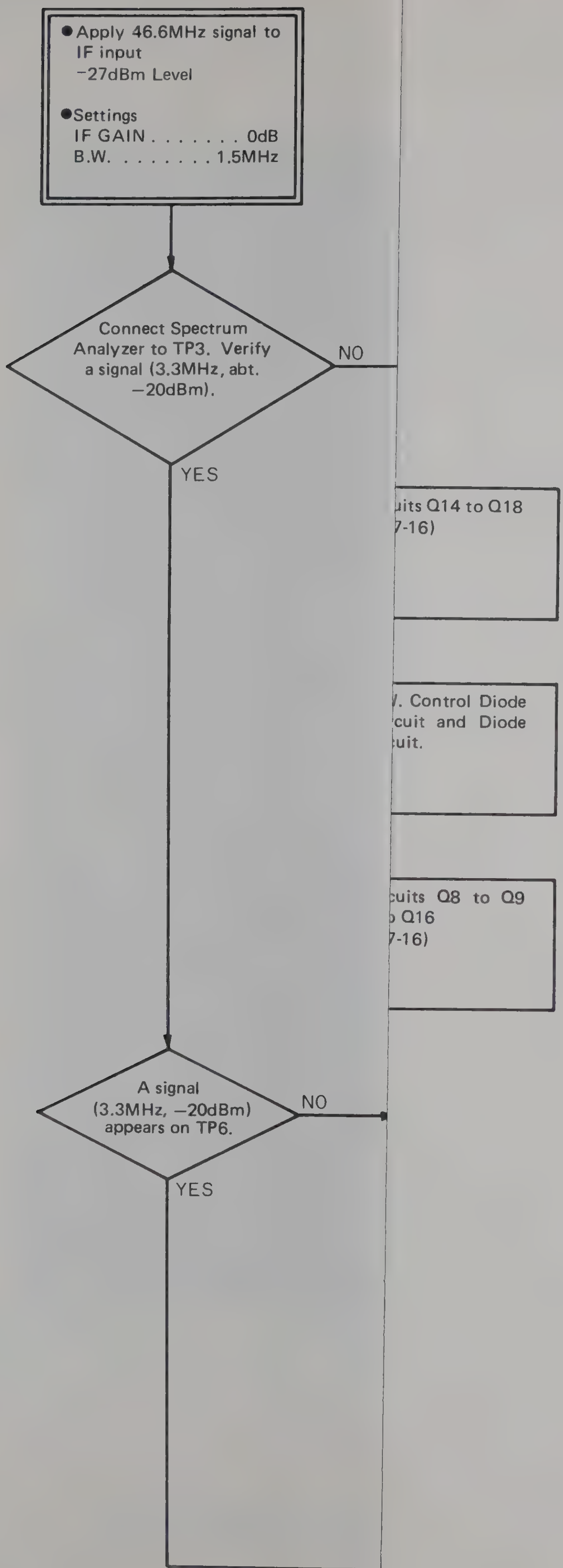


Figure 5.26
TROUBLESHOOTING CHART 4

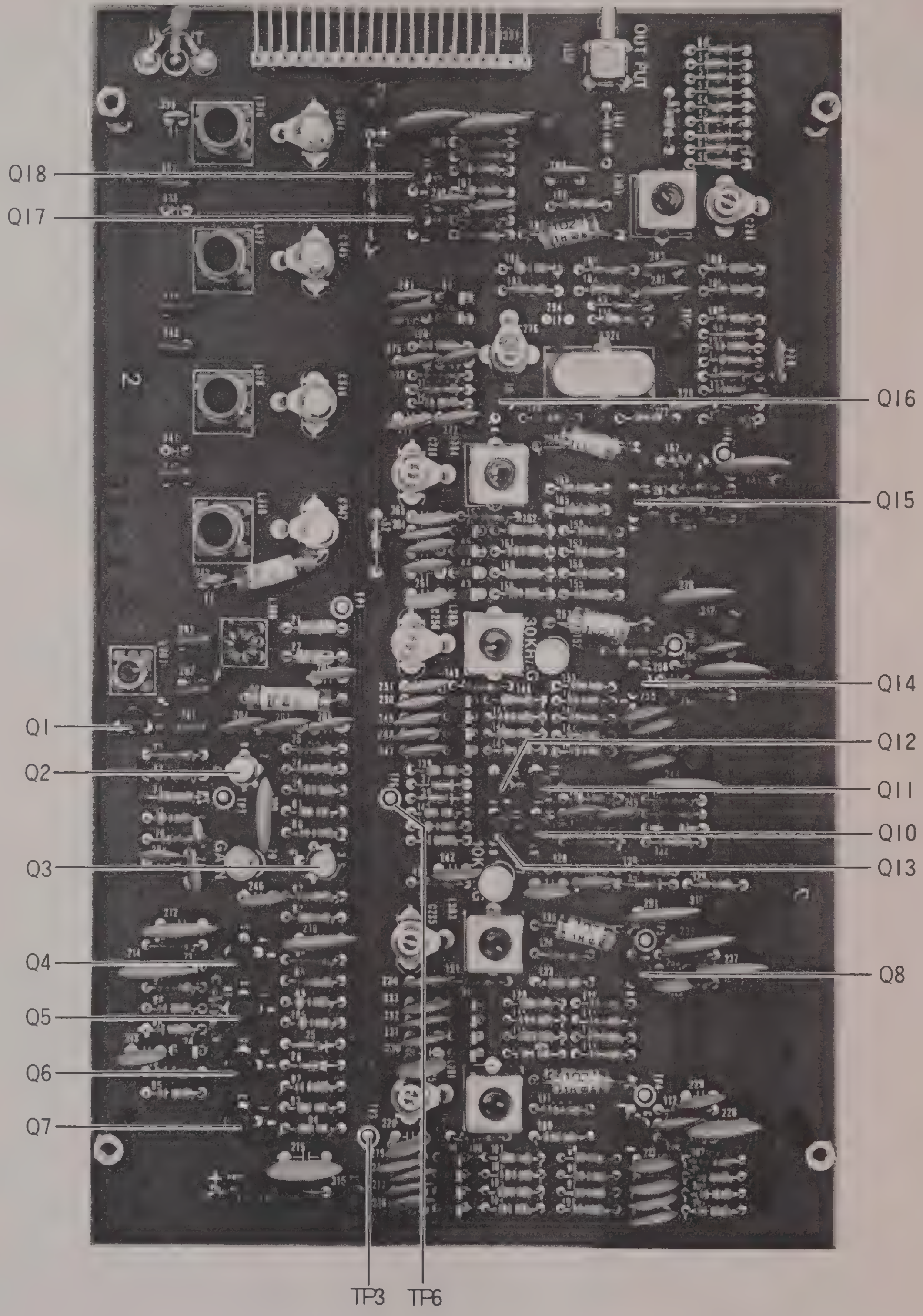


Figure 5.25 IF FILTER (SK030) CHECK POINTS

BOARD SK030 IF FILTER

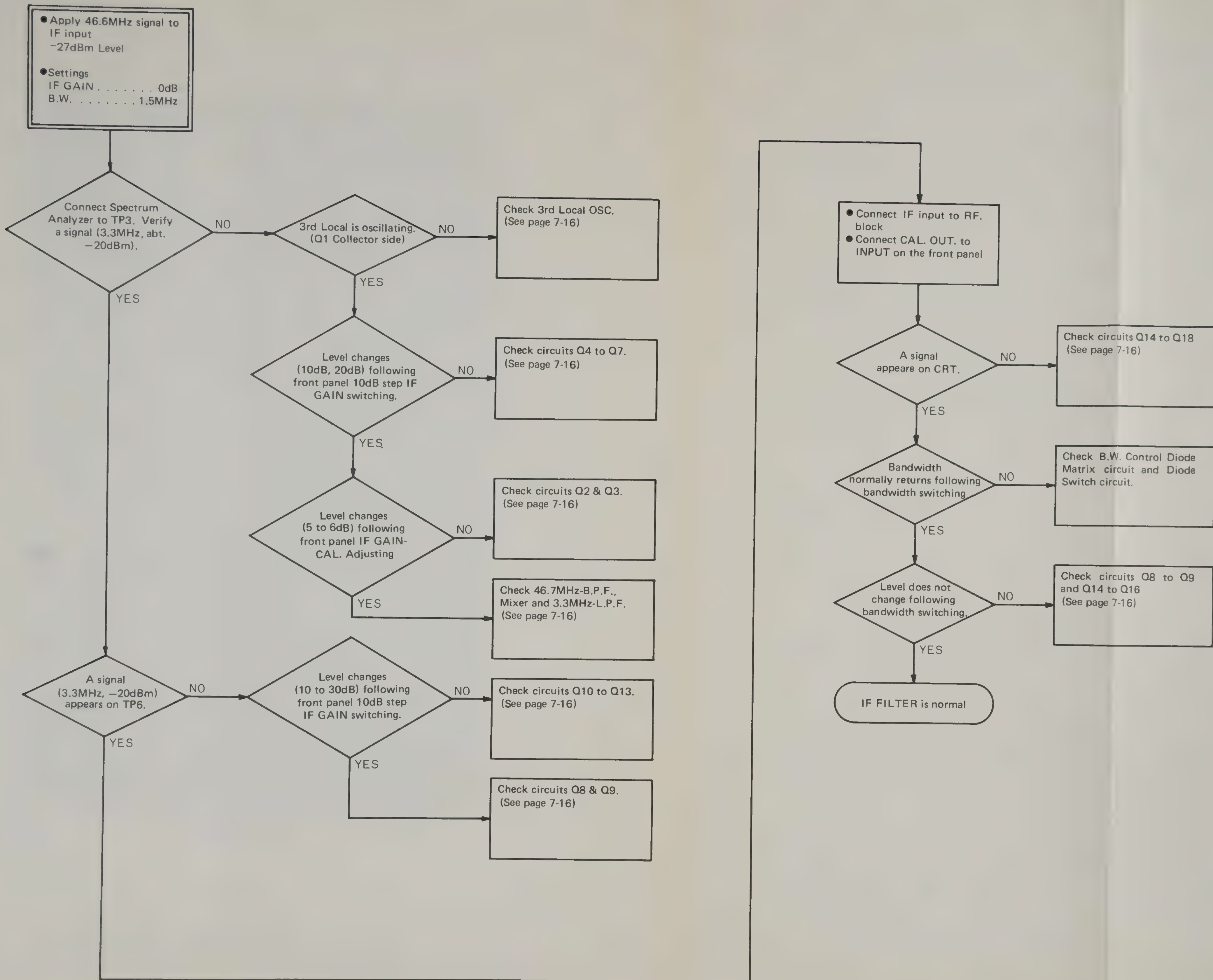


Figure 5.26
TROUBLESHOOTING CHART 4

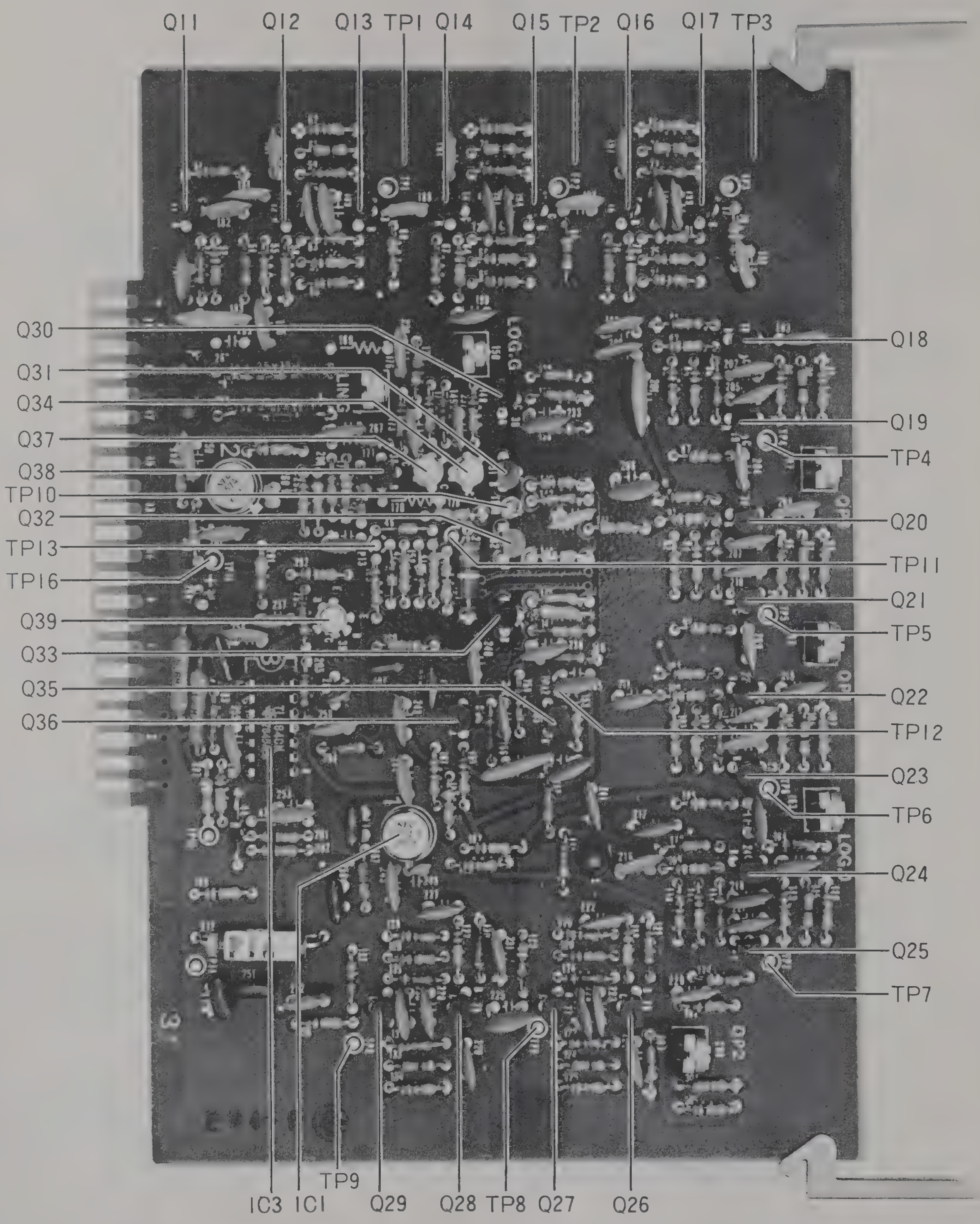
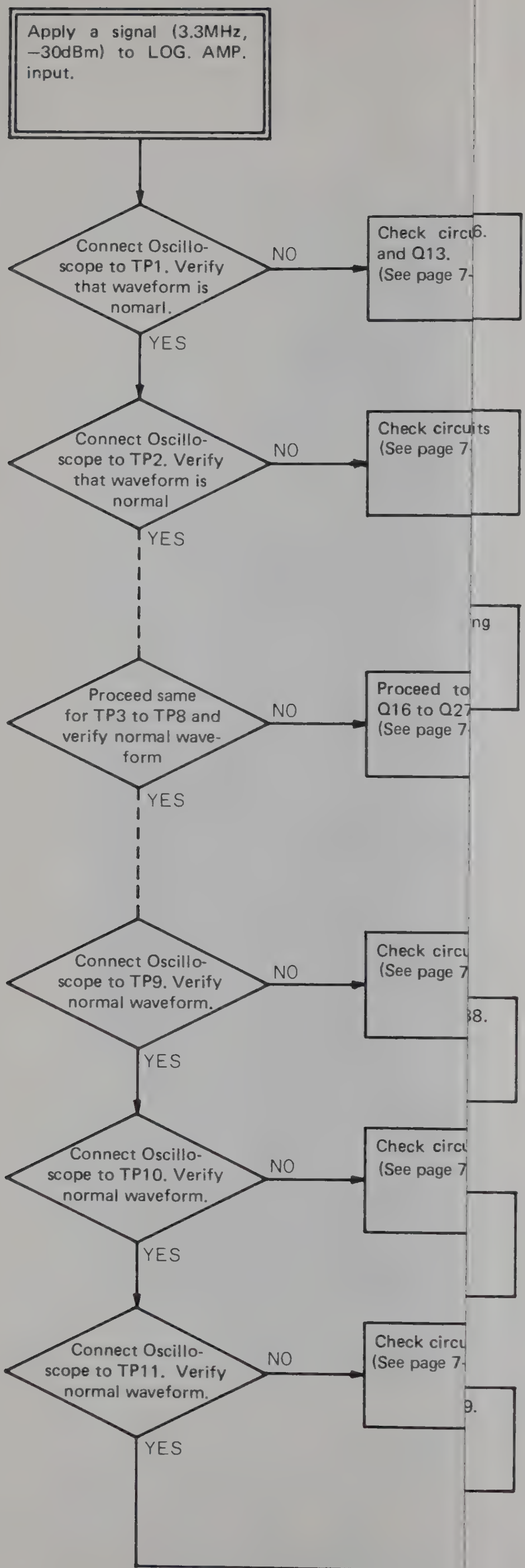
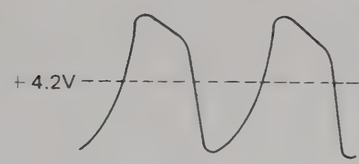


Figure 5.27 LOG AMP (PH209) CHECK POINTS

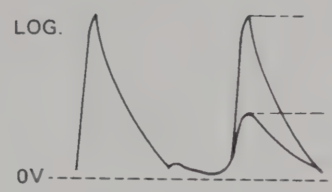
BOARD PH209 LOG. AMP.



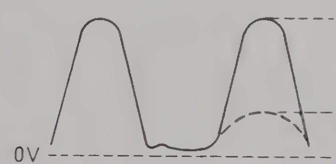
●TP12 Waveform



●TP13 Waveform



If front panel is set to LIN. or Q.P.:



●TP14 Voltage

Input Signal Level	TP14 Voltage
0dBm	4.0V
–10dBm	3.5V
–20dBm	3.0V
–30dBm	2.5V
–40dBm	2.0V
–50dBm	1.5V
–60dBm	1.0V
–70dBm	0.5V
–80dBm	0V

●TP15 Voltage (when set to Q.P.)

Input Signal Level	TP15 Voltage
–40dBm	4.0V
–50dBm	1.3V
–60dBm	0.4V
–70dBm	0.13V
–80dBm	0.04V

●TP16 Voltage (when set to Q.P.)

Input Signal Level	TP16 Voltage
–40dBm	4.0V
–50dBm	3.5V
–60dBm	3.0V
–70dBm	2.5V
–80dBm	2.0V

Figure 5.28 TROUBLE-SHOOTING CHART 5

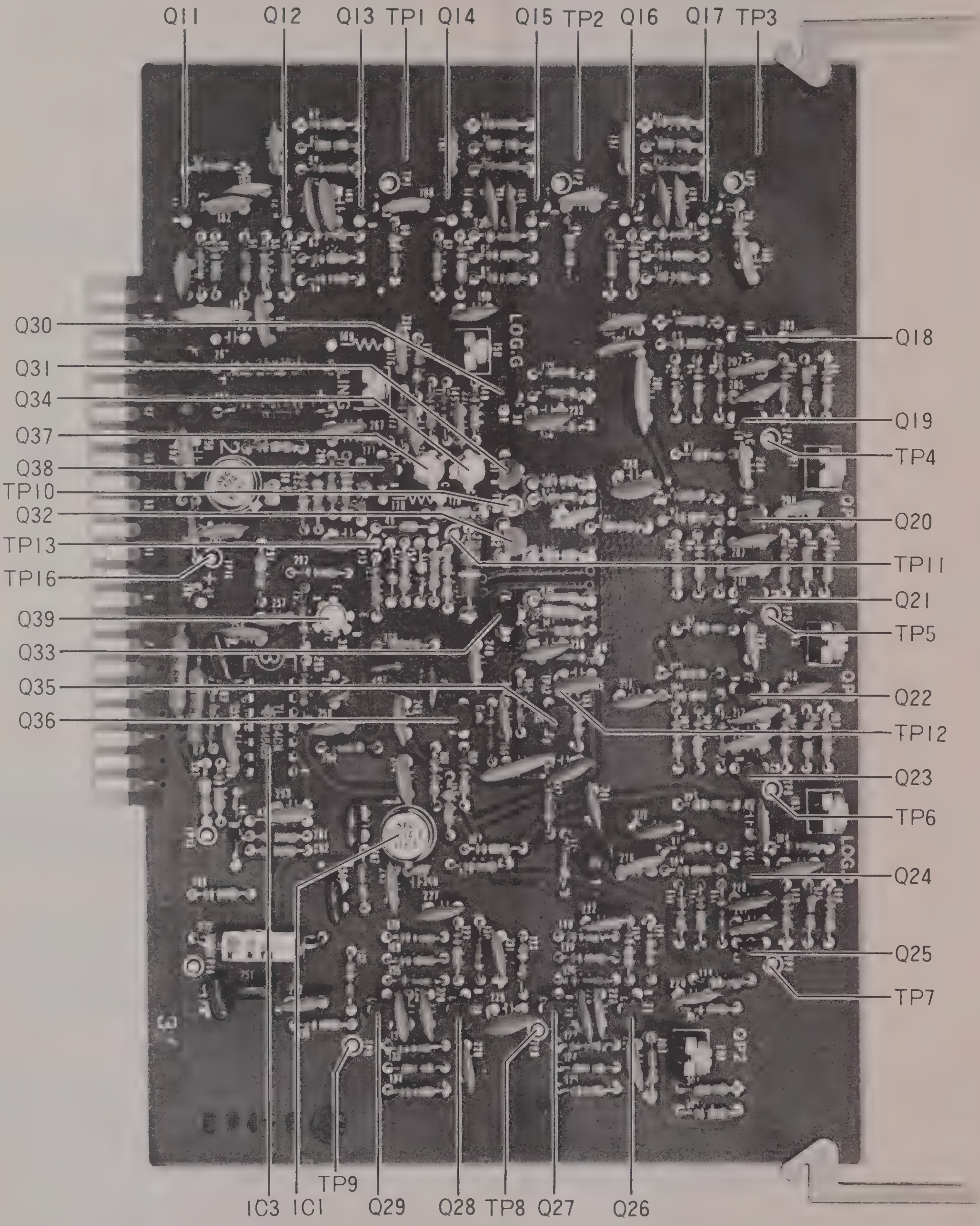
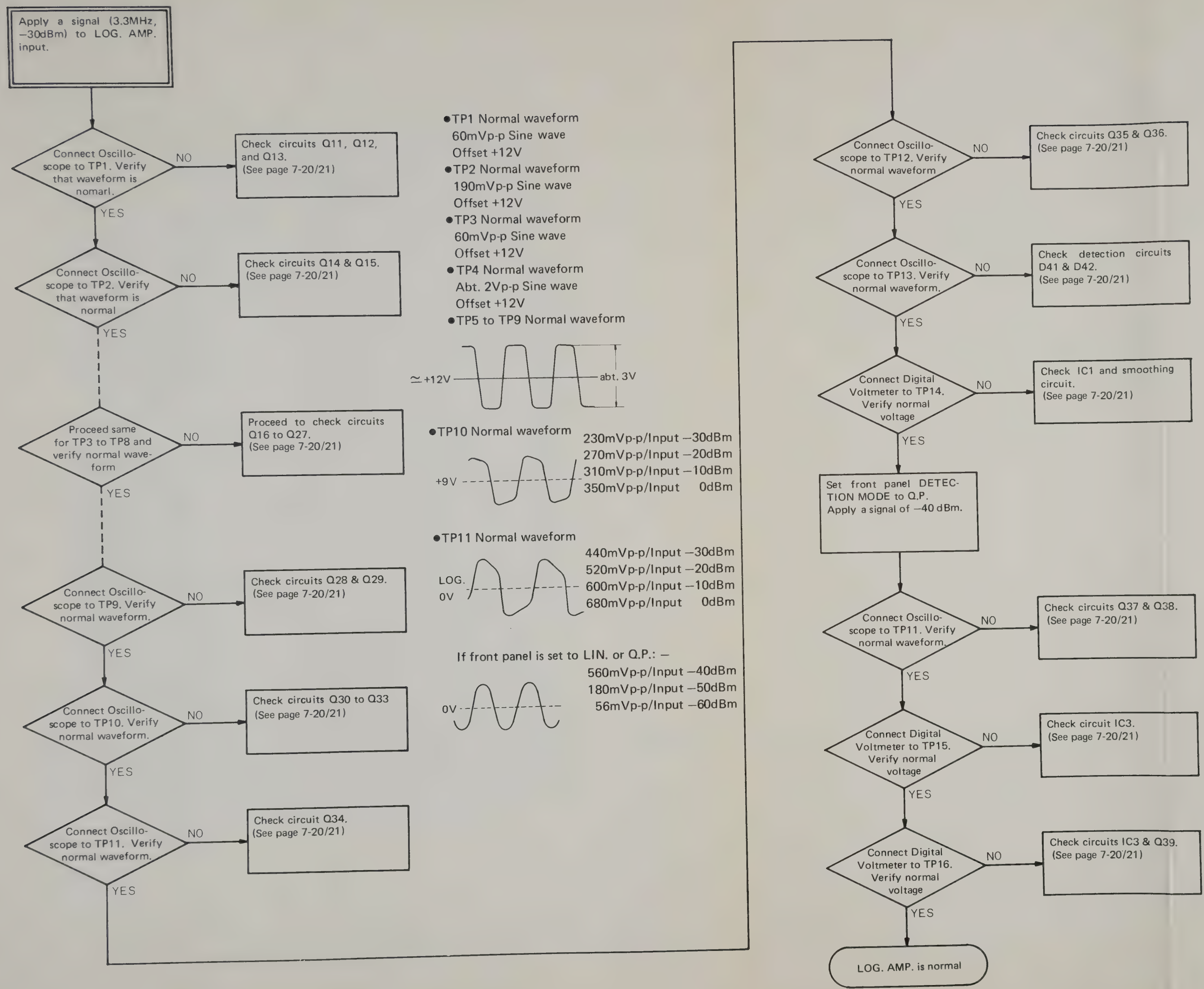
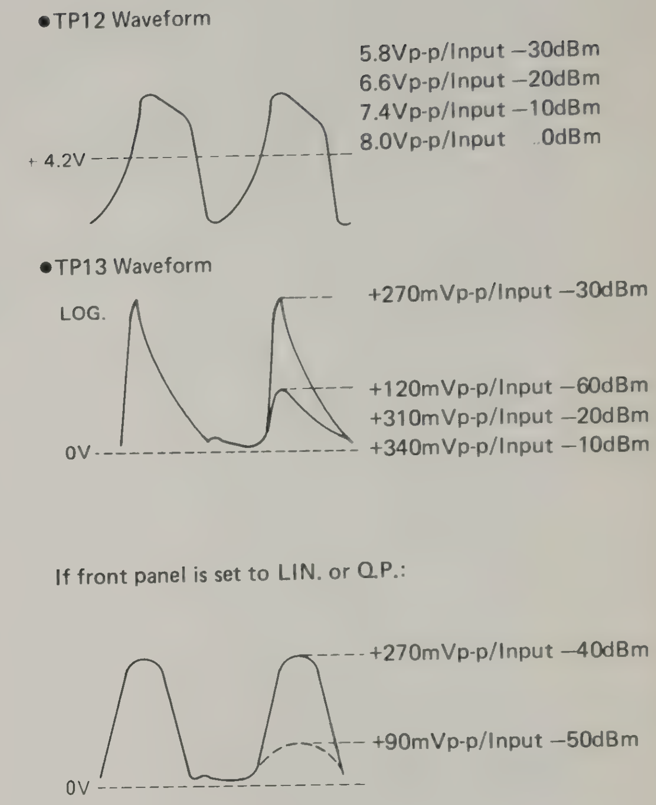


Figure 5.27 LOG AMP (PH209) CHECK POINTS





●TP14 Voltage

Input Signal Level	TP14 Voltage
0dBm	4.0V
−10dBm	3.5V
−20dBm	3.0V
−30dBm	2.5V
−40dBm	2.0V
−50dBm	1.5V
−60dBm	1.0V
−70dBm	0.5V
−80dBm	0V

●TP15 Voltage (when set to Q.P.)

Input Signal Level	TP15 Voltage
−40dBm	4.0V
−50dBm	1.3V
−60dBm	0.4V
−70dBm	0.13V
−80dBm	0.04V

●TP16 Voltage (when set to Q.P.)

Input Signal Level	TP16 Voltage
−40dBm	4.0V
−50dBm	3.5V
−60dBm	3.0V
−70dBm	2.5V
−80dBm	2.0V

Figure 5.28 TROUBLESHOOTING CHART 5

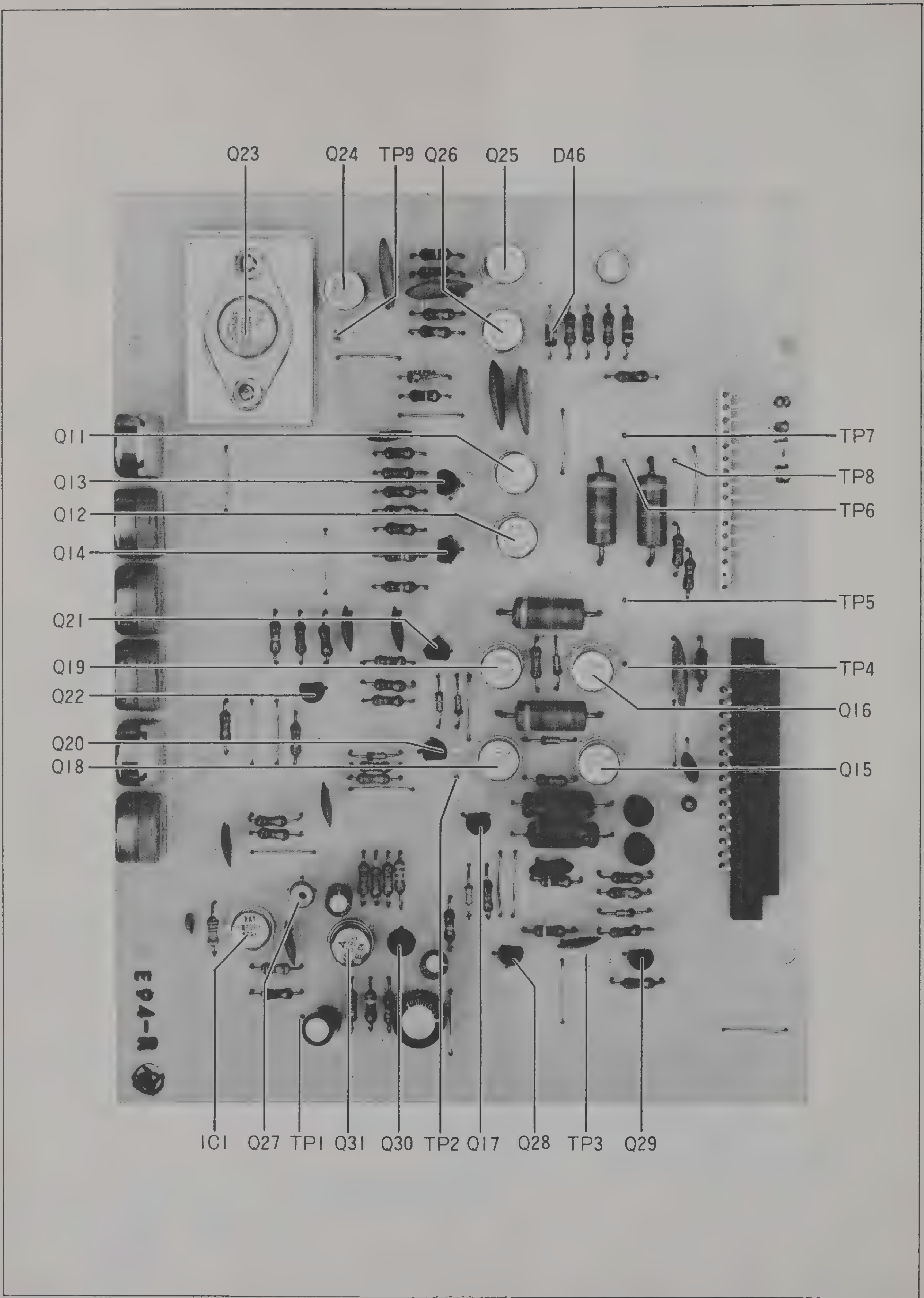
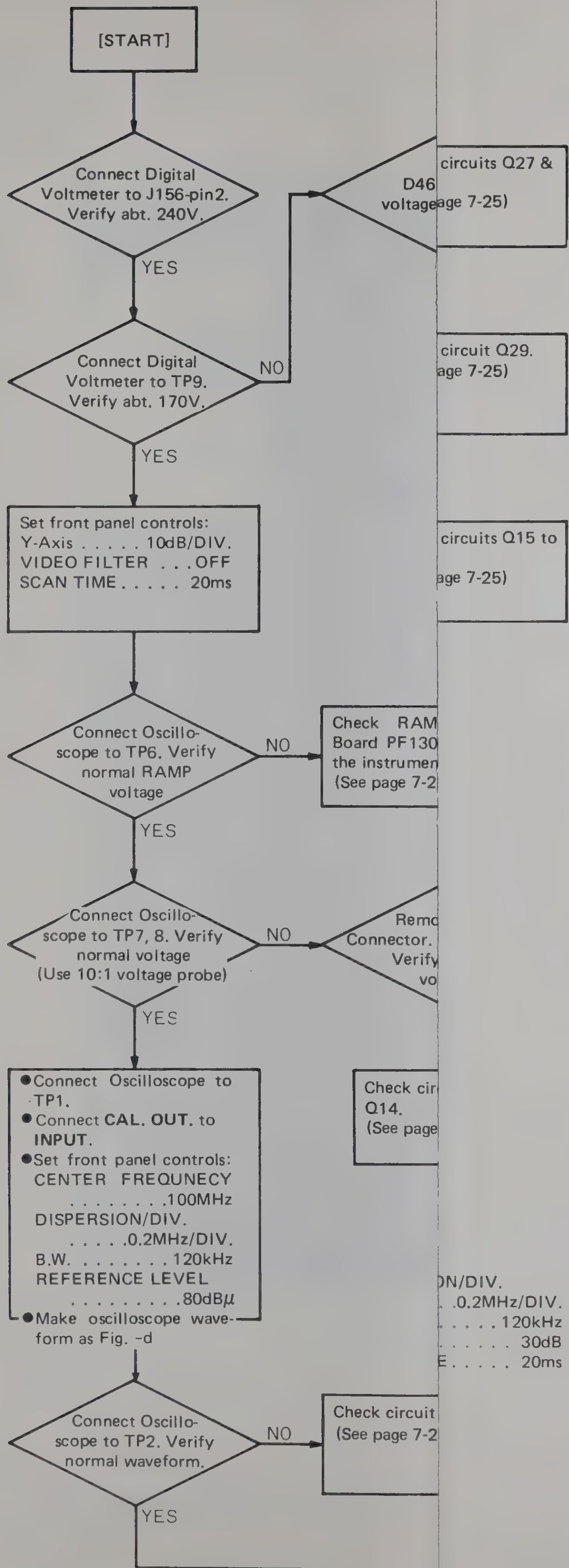


Figure 5.29 CRT DRIVER (SG210) CHECK POINTS

BOARD SG210 CRT DRIVER



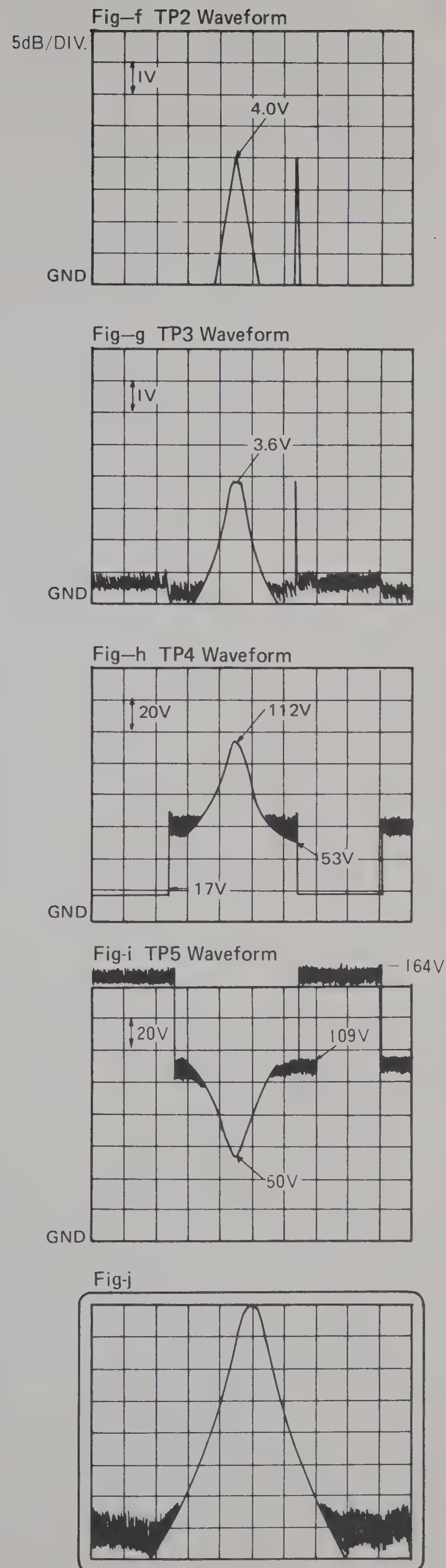


Figure 5.30
TROUBLESHOOTING CHART 6

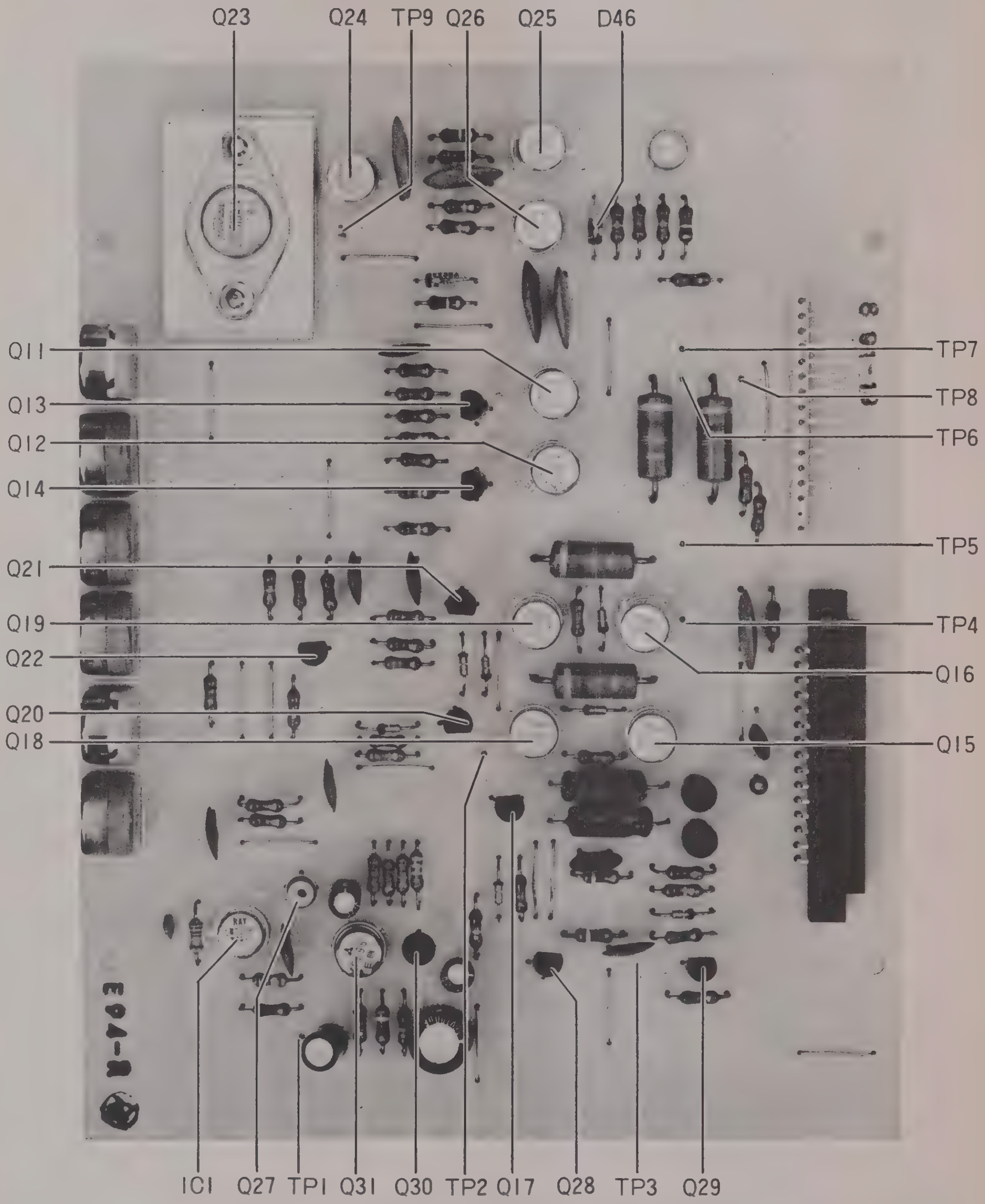


Figure 5.29 CRT DRIVER (SG210) CHECK POINTS

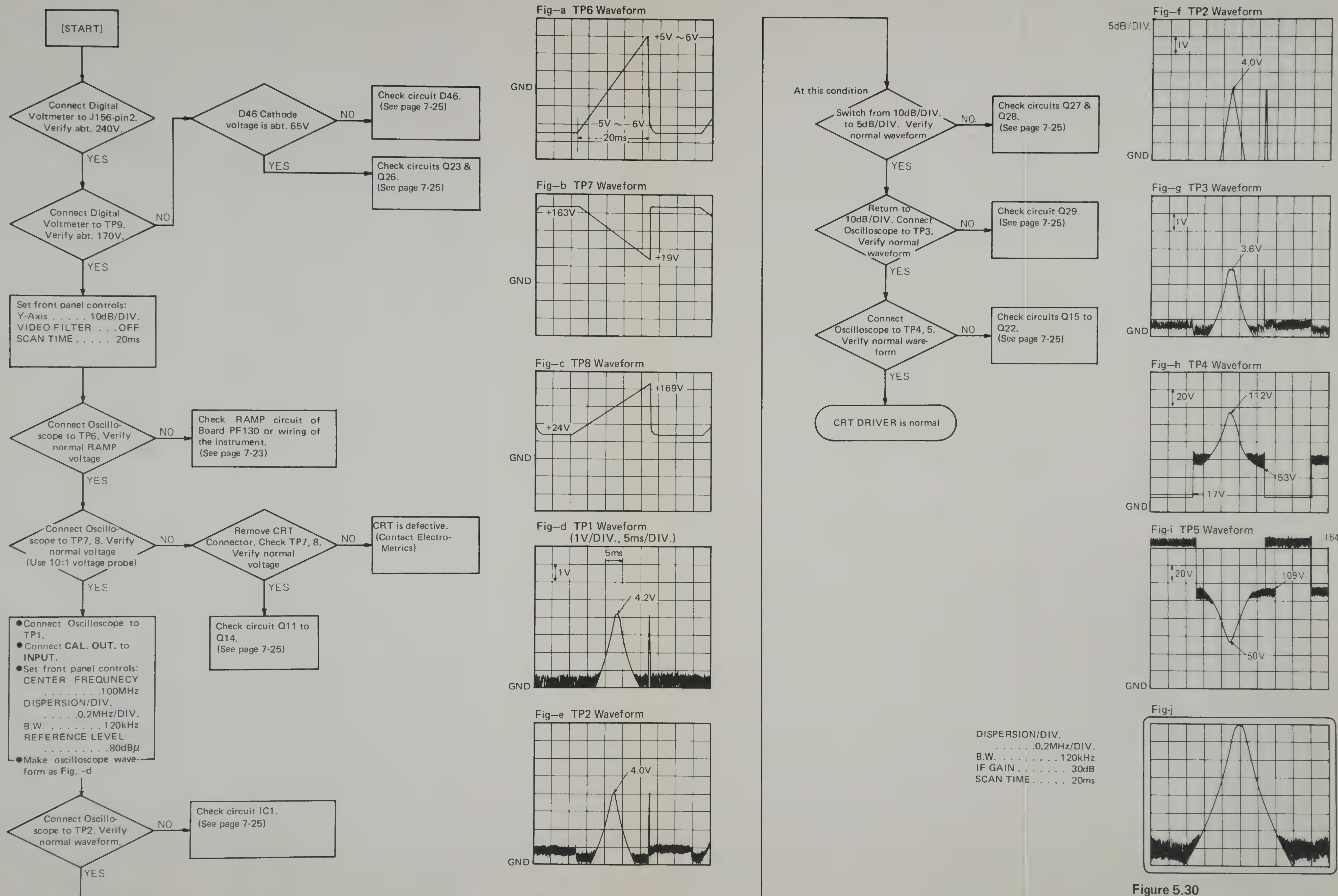


Figure 5.30
TROUBLESHOOTING CHART 6

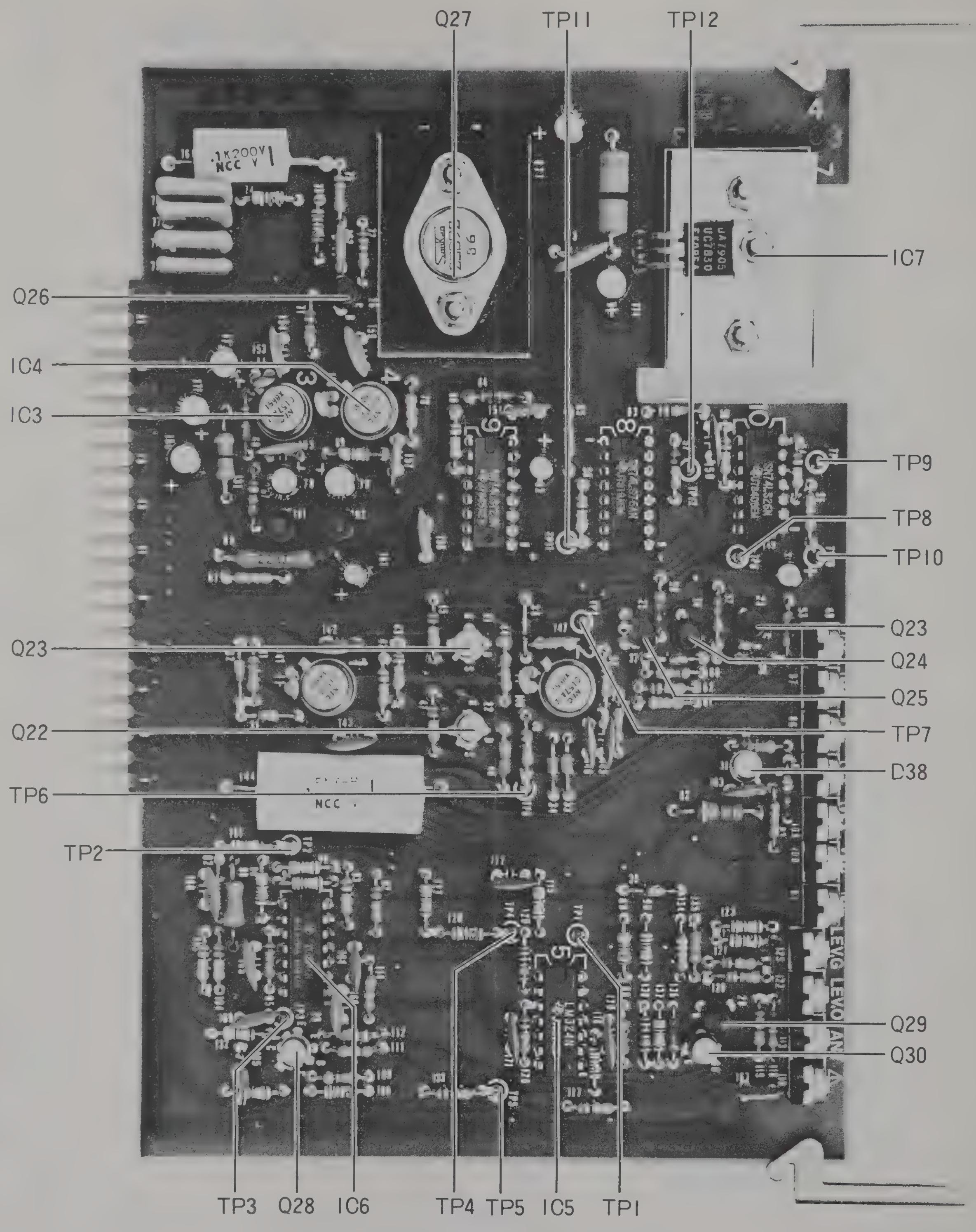
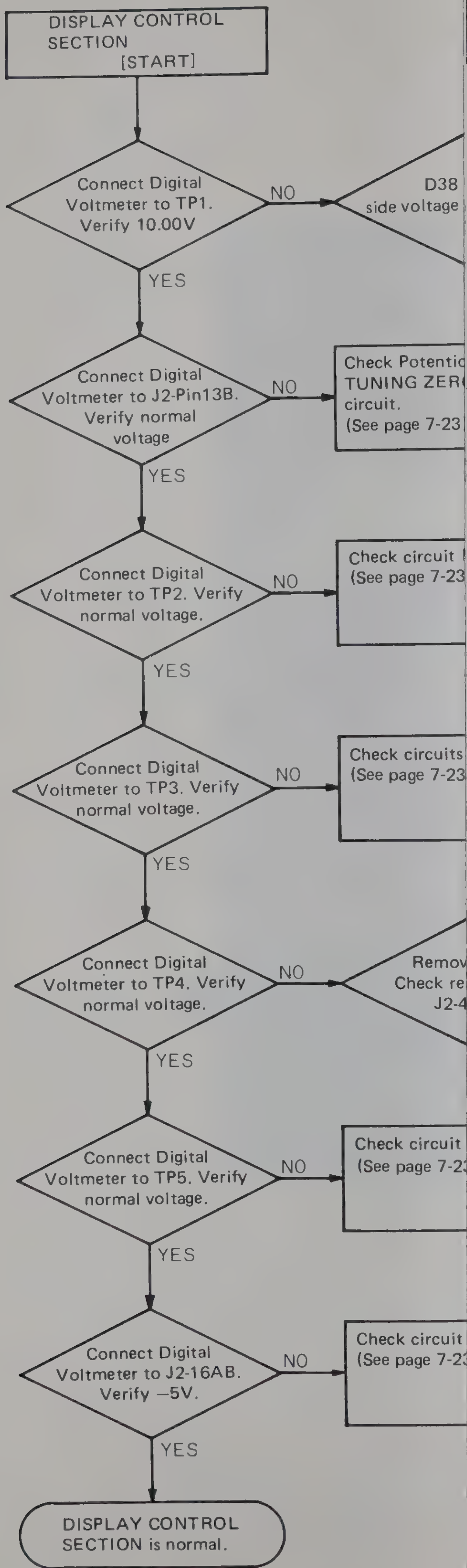
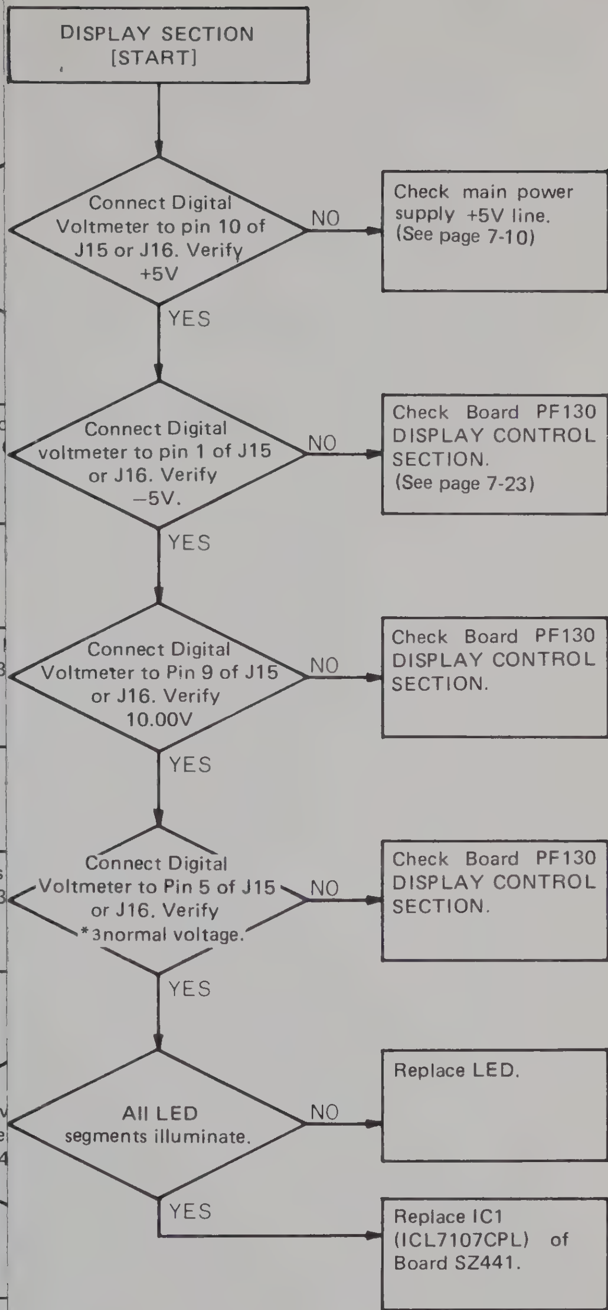


Figure 5.31 RAMP GENERATOR & YIG DRIVER (PF130) CHECK POINTS





*3. Outputs the voltage corresponding to REFERENCE LEVEL display at 1 : 1 same as TP5.

Figure 5.32
TROUBLESHOOTING CHART 7

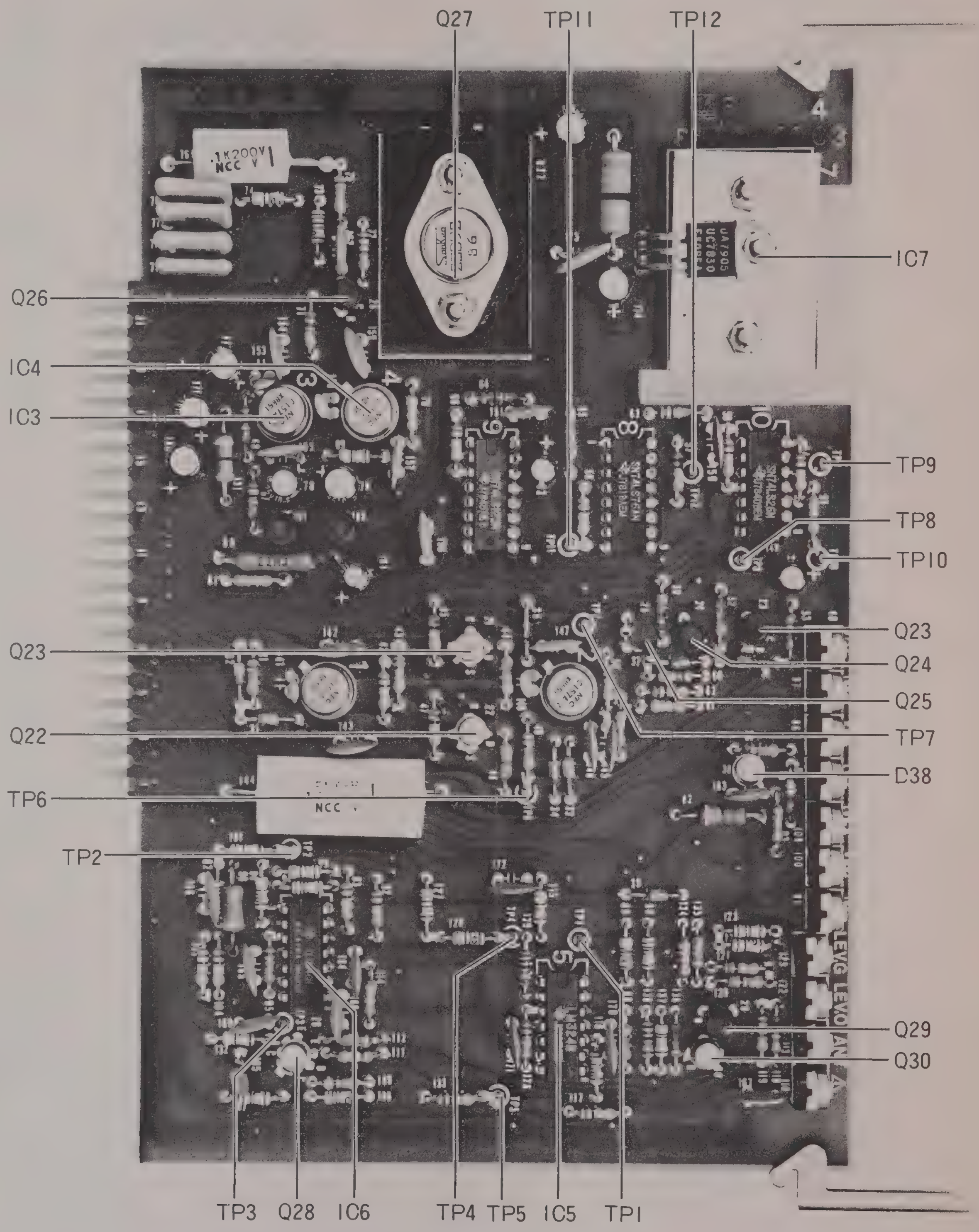
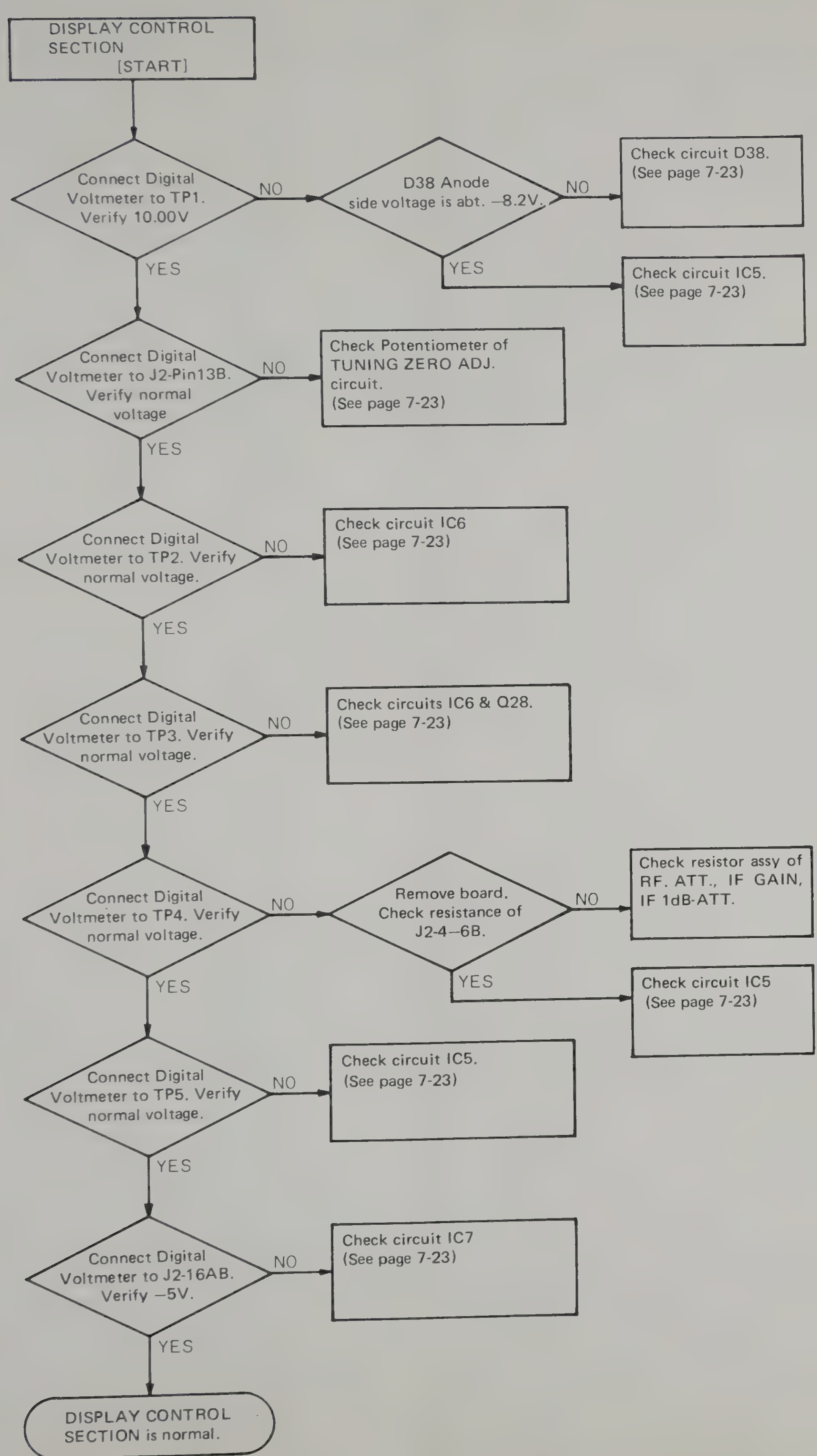


Figure 5.31 RAMP GENERATOR & YIG DRIVER (PF130) CHECK POINTS



- ●TP1 — +10.00V DC
- ●J2-13B — TUNING full ccw*1 abt. –2.7V; TUNING full cw*2 abt. –5.8V
  - *1 ccw: counter clockwise
  - *2 cw: clockwise
- ●TP2 — TUNING full ccw abt. –1V; TUNING full cw abt. +11V
- ●TP3 — At the neighbour of **CENTER FREQUENCY** 0MHz, rapidly changes in abt. +8V to abt. +1V. Thereafter becomes 0.0V at 34MHz and indicates –1.55V at 1000MHz.

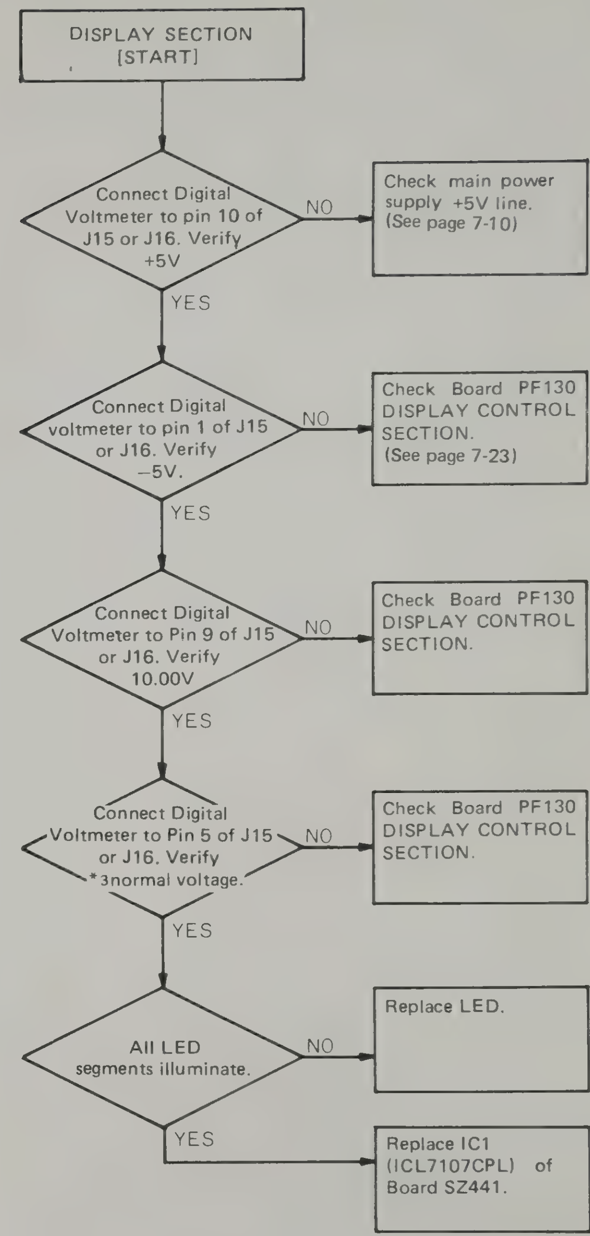
  When switching front panel control from ANT. A to ANT. B, it shows 0.25V (both ***-TR*-4132 & *-TR*-4132N**).
- ●TP4

REF. LEVEL	TP4 Voltage
80dBμ	–4.0V
90dBμ	–4.5V
100dBμ	–5.0V
110dBμ	–5.5V
120dBμ	–6.0V
130dBμ	–6.5V
140dBμ	–7.0V
150dBμ	–7.5V

*Front panel settings:
RF. ATT 0dB
IF GAIN . . . . . 0dB, CAL.
REFERENCE LEVEL
. . . . . INPUT LEVEL

- ●TP5 — **Corresponde to REFERENCE LEVEL** display at 1 : 1.
  Displaying 100 . . . . 1.00V
  Displaying 110 . . . . 1.10V

Where fluctuation of about o.01V is unavoidable due to tolerance of resistor on Board SZ441.



*3. Outputs the voltage corresponding to REFERENCE LEVEL display at 1 : 1 same as TP5.

Figure 5.32
TROUBLESHOOTING CHART 7

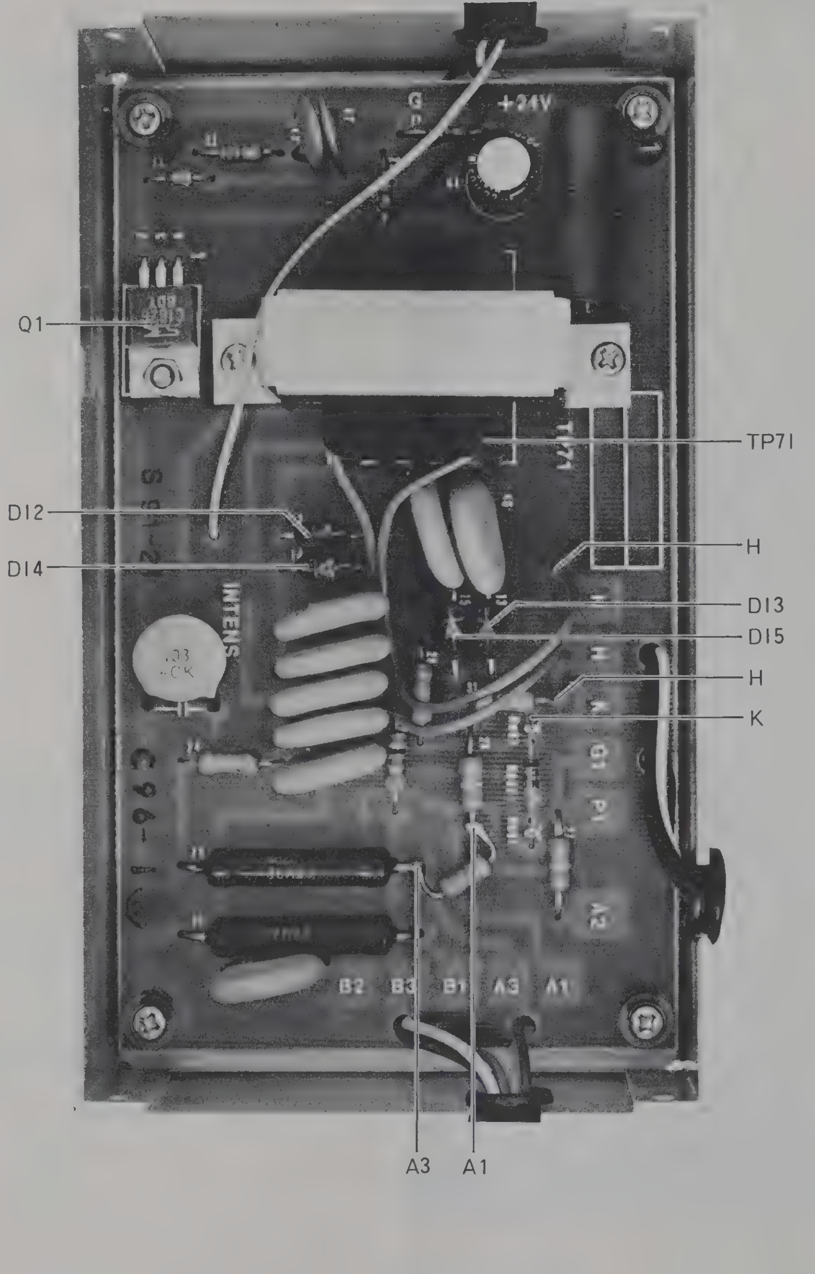
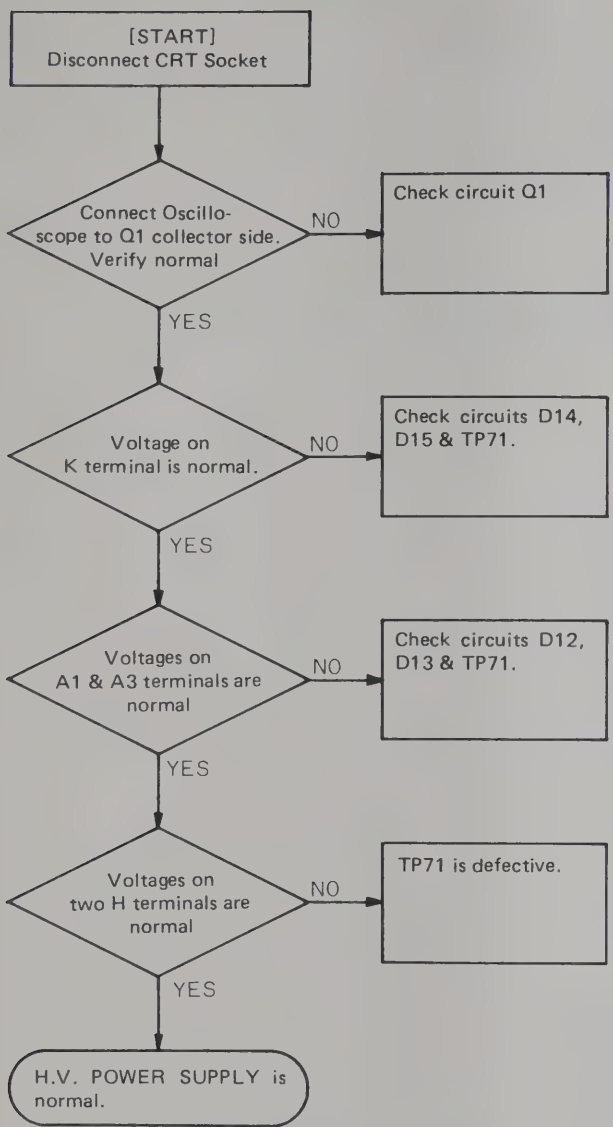
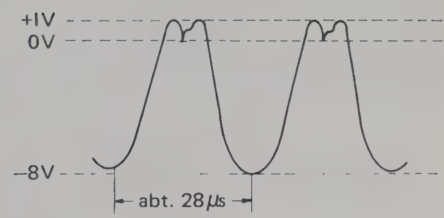


Figure 5.33 H.V. POWER SUPPLY (MEP265) CHECK POINTS

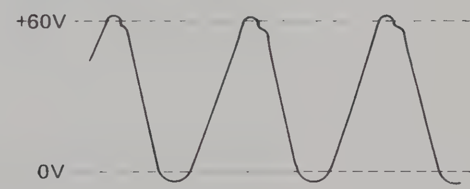
BOARD MEP265 H.V. POWER SUPPLY



●Q1 Base Voltage



●Q1 Collector Voltage



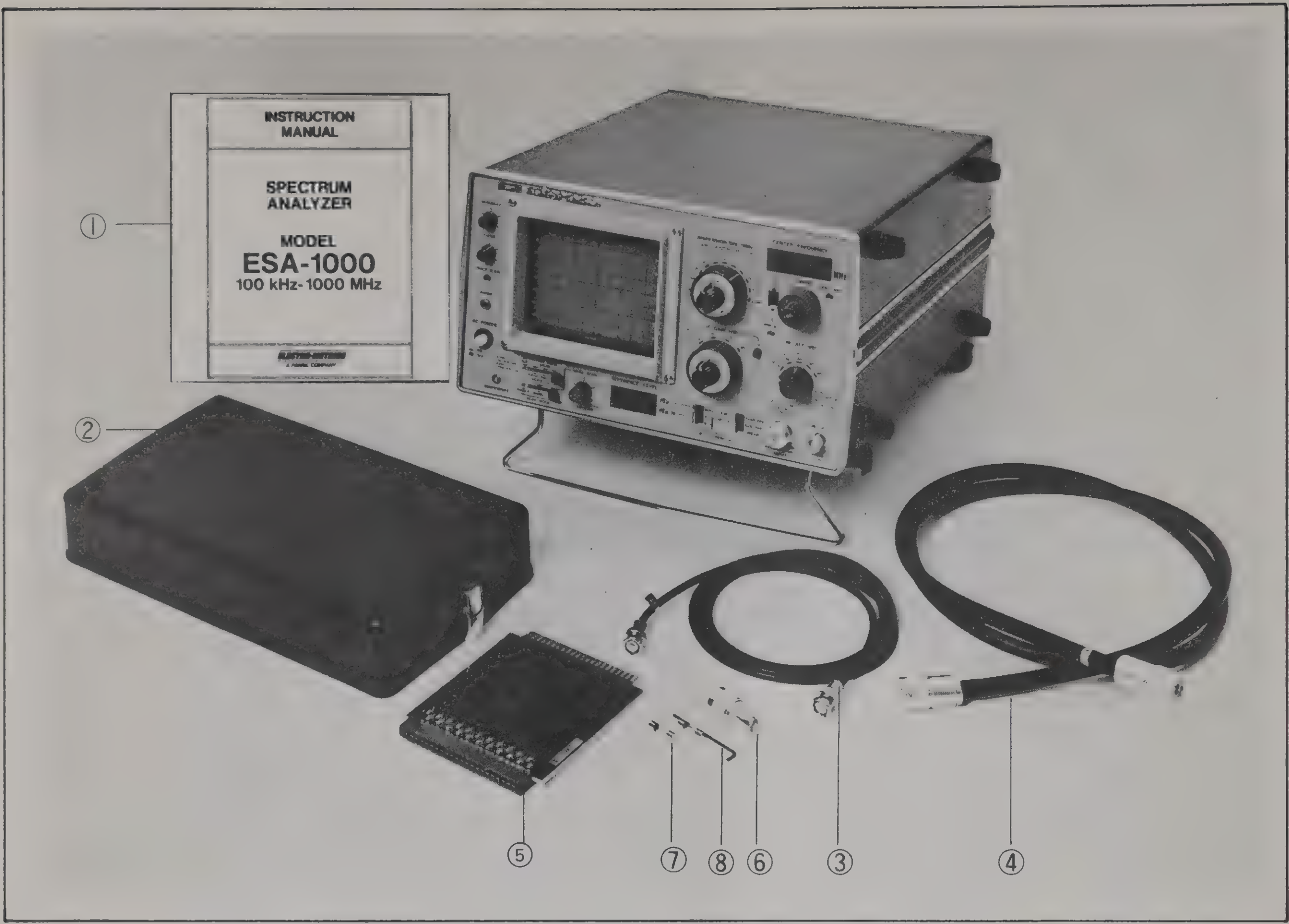
●K terminal voltage abt. –2kV
●A1 terminal voltage abt. –2.1kV
●A3 terminal voltage abt. –2kV
●H terminal voltage abt. –2kV

Figure 5.34
TROUBLESHOOTING CHART 8

SECTION VI

Accessory Data

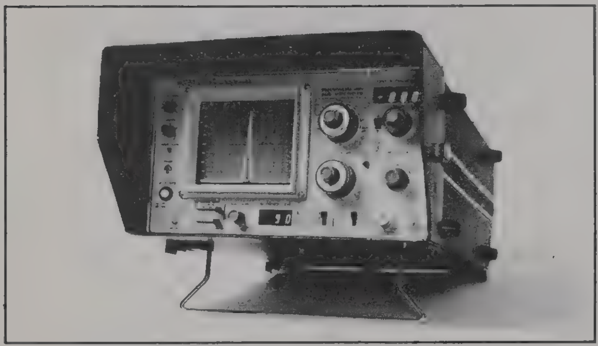
This section contains information/data on the accessory items which are applicable for utilization with the ESA-1000 Spectrum Analyzer.



ESA-1000 STANDARD ACCESSORY SET

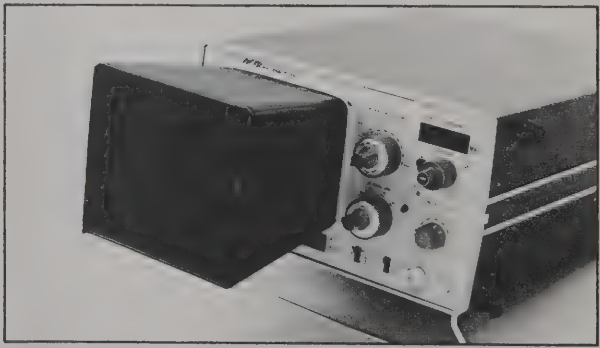
1. Instruction Manual
2. Front Panel Cover
3. BNC-BNC Cable (UG-88/μ) MI-02
4. Type N-Type N Cable (UG-21P/μ) MI-04
5. 22 Pin Extender Board
6. N-BNC Adapter (JUG-201A/μ)
7. 0.5A/115 VAC Slow Blow Fuse
8. 3 mm Hexagonal Wrench

NOTE: The power cable is connected to the instrument.



FPH-1000 Front Panel Hood

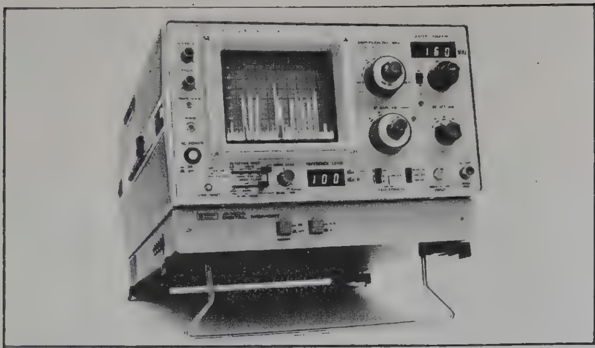
Stock No.: FPH-1000-



H-1000, CRT Hood

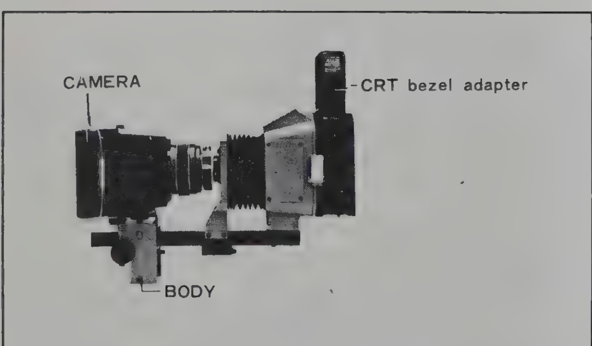
It is designed to cover the CRT section of the ESA-1000. Spectrum Analyzer for use outdoors or at bright environment.

Stock No.: H-1000-



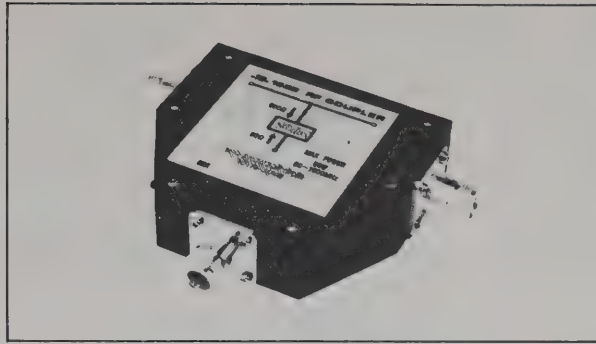
DM-1000 Digital Memory

Display resolution: X axis 9-bit 512-point
Y axis 8-bit 256-point
Horizontal input sweep rates: 20 ms to 10s
Display refresh rate: Approx. 4 ms, repetition of fullscale
Sampling error: Y axis, within ±25%
Store function: Content of memory is stored by setting **SCAN MODE** to **"MANUAL".**
Display function: A Content of memory A displayed.
A/B Content of memory A and B displayed
Operating temperature range: 0°C to +40°C
Power requirement: Supplied from ESA-1000
Power consumption: Approx. 25 VA
Dimensions: about 11.4"(W) x 1.6"(H) x 15.3"(D) (290 x 40 x 390 mm)
Weight: about 7.0 lbs. (3.2 kg)
Stock No.: DM-1000- (Factory Option)



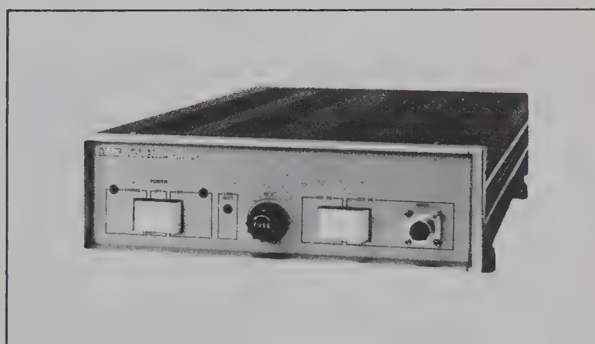
Camera Mount Complete Set
CAM-1000

This set is composed of camera mount, camera and attachment, and is stored in a steel bag.



C-1000 RF Coupler

Frequency range: DC to 1000 MHz
Maximum input: 50 W
Coupling degree: 40 dB ± 1 dB
Impedance: 50/main & sub routes
V.S.W.R.: 1.5 or less
Insertion loss: 1 dB or less
Connector: Main route/N type, sub routes/ BNC type
Stock No.: C-1000-



BAT-1000 Battery Pack

Internal battery capacity: 10 AH (12V) Ni-Cd
Continuous operating hour
: about 3.0 hours
Charging hour : about 15 hours
External battery: +10V to +15V
Discharging hour: AC100V ± 10%, 50/60 Hz, about 35VA
Environmental temperature
: 0°C to +35°C (in operation)
Dimensions: abt. 11.6"(W) x 3.5"(H) x 19.7"(D) (294 x 87 x 500 mm)
Weight: about 26 lbs. (12 kg)
Stock No.: BAT-1000-

Other Accessories Include:

1. EXY-125B: 11:: x 17:: X-Y Plotter (single pen)
2. EHF-25: High intelligibility earphones
3. HPF-30: 30 MHz high pass filter
4. LPF-30: 30 MHz low pass filter
5. LPF-1000: 1000 MHz low pass filter
6. ICC-1000: Instrument carrying case
7. PCL-25: Clamp-on probe, 10 kHz to 110 MHz
8. TRI-25: Tripod-rugged
9. MSA-25: Mast section — 20 inches

CIG-25 IMPULSE GENERATOR

SPECIFICATIONS

Electrical

Frequency Range: 10 kHz to 1000 MHz
Average VSWR: 1.7:1
Repetition Rate: 1 to 100 Hz
Impedance: Matched to 50 ohms
Calibrated Frequency Range: 10 kHz to 1000 MHz
Output connector: TNC

Mechanical

Length:	11-7/8"
Width:	8-3/16"
Height:	5-13/16"
Weight:	6 lbs.

GENERAL DESCRIPTION

Calibrated Impulse Generator, Model CIG-25, is a reliable source of calibrated impulses at variable repetition rates.

The CIG-25 provides a repetition rate variable between 1 and 100 Hz, (1 Hz steps between 1 and 10 Hz, 10 Hz steps between 10 Hz and 100 Hz) and a provision for synchronizing with, and operating at the AC line frequency. A front-panel push-button switch also provides for generating a single impulse.

A front-panel switch provides for selection of either positive or negative polarity of the impulse, thus facilitating checks for possible overload of a defice under test.

APPLICATIONS

The CIG-25 Calibrated Impulse Generator is an ideal calibrating standard for use with RF noise meters. It can also be used for receiver alignment, bandwidth measurements, and for checking transient response.

The CIG-25 is designed specifically for operation in conjunction with Electro-Metrics Interference Analyzer Model, EMC-25 or CPR-25 and the ESA-1000 Spectrum Analyzer.

Certification is tracible to the National Bureau of Standard.

EFP-25 ELECTRO-STATIC FIELD PROBE

SPECIFICATIONS

Electrical

Frequency Range:	10 kHz — 1000 MHz
Impedance:	50 ohms nominal
Output Connector:	TNC

Mechanical

Length:	11"
Diameter:	1¼"
Weight:	1 lb.

GENERAL DESCRIPTION

The EFP-25 Electro-Static Field Probe is designed to operate in conjunction with Electro-Metrics Interference Analyzer, Model EMC-25, CPR-25, or other 50 ohm input impedance receivers.

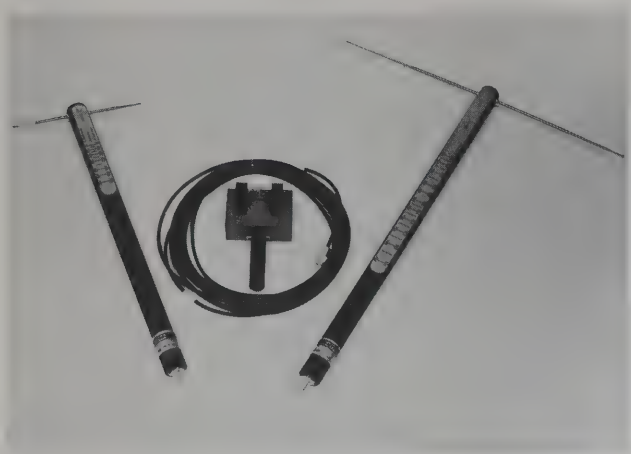
The EFP-25 covers the frequency range of 10 kHz to 1000 MHz which matches bands 1-15 on the EMC-25 and CPR-25 and the 100 kHz to 1000 MHz range of the ESA-1000 Spectrum Analyzer.

The EFP-25 probe is non-calibrated and hand held for versatility and mobility.

APPLICATIONS

The EFP-25 Electro-Static Field Probe is particularly suited for searching for radio frequency (RF) leakage.

The probe is especially useful in determining the side of an article under test which radiates the highest level prior to running a MIL-STD or FCC radiated emissions test.



TDS-25 TUNABLE DIPOLE SET

SPECIFICATIONS

Electrical
Frequency Range: 200 to 1000 MHz
TDS-25-1: 200 to 500 MHz
TDS-25-2: 500 to 1000 MHz
Impedance: Matched to 50 ohms
Calibrated Frequency Range:
200 to 100 MHz Antenna Factor
Charts furnished with each antenna
Output Connector: TNC

Mechanical:
Height: TDS-1 23"
TDS-2 18"
Weight: 2 lbs.
Length: adjustable

GENERAL DESCRIPTION

The tuned dipole is the reference antenna for both FCC and VDE measurements in the 200 to 1000 MHz range. Results from other linearly-polarized antennas in the verification/certification process must be correlated with the results obtained from a tuned dipole.

The adjustable dipole is used for radiated emissions compliance testing when used with a 50 ohm input impedance field intensity meter.

When used with Electro-Metrics interference analyzers, the coverage range of 200 to 1000 MHz matches that of bands 14 (200-500 MHz) and band 15 (500-1000 MHz).

Included within the structure of each dipole mount is a balum transformer which transposes the balanced dipole to the unbalanced coaxial line.

APPLICATIONS

The TDS-25 is designed for measuring field strength intensities in conjunction with Military, FCC, VDE and ANSI specification. The TDS-25 is equipped with coaxial cable CAC-25 and clamp mount CMT-25 which attaches to optional Tripod TRP-25 or Mast Section MSA-25 by means of Antenna Mount (AMT-25) (optional).

TDS-25 ANTENNA FACTOR CHART

TDS-25-1		TDS-25-2	
Antenna Factor (dB)	Dipole Length (MHz)	Antenna Factor (db)	Dipole Length (MHz)
200-500 MHz		500-1000 MHz	
25	500	32	1000
24	450	31	900
23	400	30	800
22	350	28	700
21	325	27	600
20	300	26	550
19	280	25	500
18	260		
18	240		
17	220		
16	200		

TDA-25 TUNABLE DIPOLE ANTENNA

SPECIFICATIONS

Frequency Range: 30-200 MHz
Impedance: 50 ohms
Calibrated Frequency Range:

30-200 MHz
Frequency conversion tape is calibrated with necessary antenna correction factors
Output Connector: TNC
Length: 15.6 ft at 30 MHz
Width: 2"
Diameter: 2.3 ft at 200 MHz
Height: Boom 23-9/16" over all

GENERAL DESCRIPTION

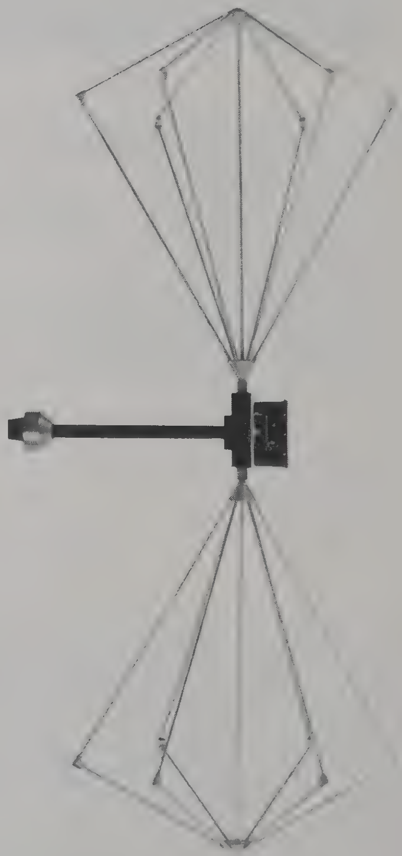
The TDA-25 is designed to operate over the 30-200 MHz frequency range. The two sets of elements are made from stainless steel plus a fixed-length extension rod also made of stainless steel. The elements mount in a balun network fabricated of phemolic and the necessary impedance matching components. The adjustable dipole elements are set by using the frequency conversion scale (FCS-25).

APPLICATIONS

The TDA-25 complements the TDS-25 to provide tuned dipole coverage for the full range of radiated measurements to comply with the latest FCC and SAE specifications. The TDS-25 is equipped with coaxial cable to CAC-25 and clamp mount CMT-25 which attaches to optional Tripod TRP-25 or Mast Section MSA-25 by means of Antenna Mount AMT-25 (also optional).

TDA-25 FREQUENCY TO INCH CONVERSION

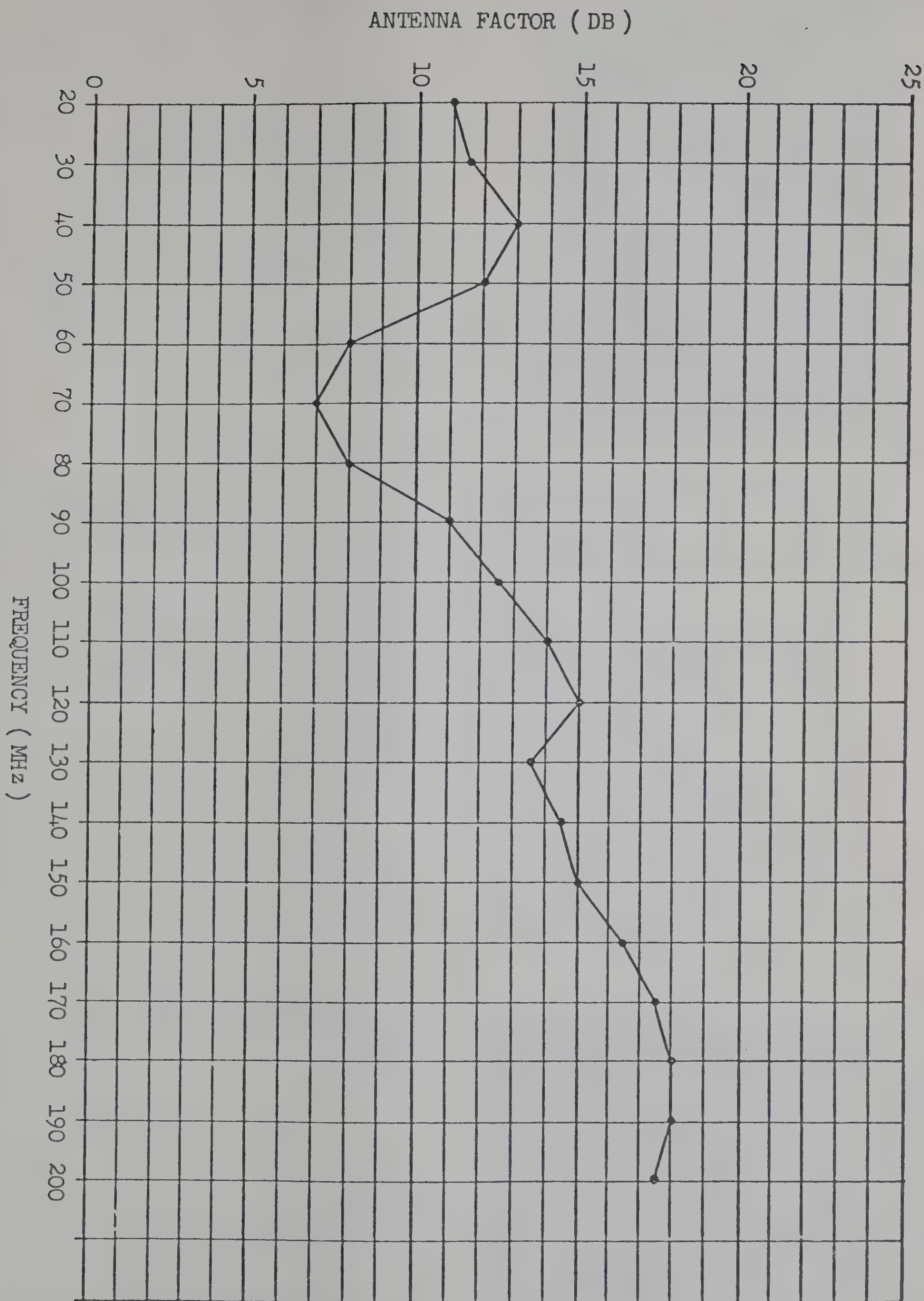
FREQUENCY (MHz)	INCH	ANT FACTOR (dB)
200	14.000	16.0
190	14.750	15.0
180	15.652	14.5
170	16.500	14.0
160	17.562	13.5
150	18.687	13.0
140	20.062	12.5
130	21.562	12.0
120	23.375	11.0
110	25.500	10.0
100	28.062	9.5
—	29.500	
90	31.187	8.5
—	33.000	
80	35.062	7.5
—	37.375	
70	40.062	6.5
—	43.187	
60	46.750	5.0
—	51.000	
50	56.125	3.5
—	58.437	
—	61.000	2.5
—	63.750	
—	66.812	
40	70.125	1.5
—	73.812	
—	77.937	
—	82.500	
—	87.625	
30	93.500	-1.0



BIA-25 BICONICAL ANTENNA

SPECIFICATIONS

Electrical
Frequency Range: 20 to 200 MHz
Impedance: Matched to 50 ohms
Calibrated Frequency Range:



TYPICAL ANTENNA FACTOR CHART
FOR
THE BIA-25 BICONICAL ANTENNA

20 to 200 MHz Antenna Factor
Chart furnished with each antenna

Output Connector: TNC
Type "N"
(on request)

Mechanical

Length: 56.5 in. tip-to-tip
Diameter: 21 in. maximum
Depth: 32 in. incl. balun
Weight: 6 lb.

GENERAL DESCRIPTION

The BIA-25 Biconical Antenna was designed to operate over the 20-200 MHz frequency range to meet military and other EMI specifications. The BIA-25 is capable of operating either as a transmitting antenna (100 watts max.) or as a receiving antenna over the frequency range of 20 MHz to 200 MHz.

The Biconical elements are made from aluminum rods and are joined by tack welds. The elements mount in a balun network fabricated of phenolic and the necessary impedance-matching components.

Upon request, we also offer a collapsible biconical. Elements can be conveniently disassembled for travel or storage.

APPLICATIONS

The BIA-25 Biconical Antenna is particularly suited to radiated emission and susceptibility specification compliance testing such as is outlined in MIL-STD-826A and MIL-STD-462.

The broadband frequency capability of the BIA-25 eliminates the need for band switching, element extension or external tuning when used for EM ambient surveys or spectrum signature measurements.

LPA-25 LOG PERIODIC ANTENNA

SPECIFICATIONS

Electrical

Frequency Range: 20 to 1000 MHz
Impedance: Nominal to 50 ohms
Calibrated Frequency Range:
20 to 1000 MHz Antenna Factor
Chart furnished with each antenna
Output Connector: Type "N"
Power Handling Capability: 200 watts C.W.

Mechanical

Weight: 10 lbs.
Length: 36"
Width: 40"

GENERAL DESCRIPTION

The LPA-25 Log Periodic Antenna was designed to operate over the 20 to 1000 MHz frequency range to meet military and other EMI specifications.

The broadband frequency capacity of the LPA-25 eliminates the need for band switching, element extension or external tuning when used for EMI ambient surveys or spectrum signature measurements.

APPLICATIONS

The LPA-25 is capable of operating either as a transmitting or as a receiving antenna over the frequency range of 20 to 1000 MHz. Linearly-polarized design permits separate measurement of horizontal and vertical electric field components over its established range.

The LPA-25 Log Periodic Antenna is particularly advantageous for use in radiated emission and susceptibility specification compliance testing such as outlined in MIL-STD-826A and MIL-STD-462.

BDA-25 BROADBAND DIPOLE ANTENNA

SPECIFICATIONS

Electrical

Frequency Range: 20 to 200 MHz
Impedance: Matched to 50 ohms
Calibrated Frequency Range:
20 to 200 MHz Antenna Factor
Chart furnished with each antenna
Output Connector: TNC

ALR-25(M) MANUAL LOOP ANTENNA

Mechanical
Length:
Main: 19" 100-200 MHz
Extensions: 21" – 45-100 MHz
36" – 20–45 MHz

GENERAL DESCRIPTION

The tuned dipole is the reference antenna for both the FCC and VDE measurements in the 30 to 1000 MHz range. Results from other linearly-polarized antennas in the verification/certification process must be correlated with the results obtained from a tuned dipole.

The BDA-25 Broadband Dipole Antenna is designed specifically for operation in conjunction with Electro-Metrics Interference Analyzer Model EMC-25 or CPR-25. Its coverage of 20 to 200 MHz matches that of Bands 11-13 of the EMC-25 and CPR-25, plus the ESA-1000.

Included within the structure of the dipole mounting is a balun transformer which transposes the balanced dipole to the unbalanced coaxial line is slightly mismatched to provide optimum broadbanding of its reception characteristic.

APPLICATION

The BDA-25 is designed for measuring field strength intensities and is fixed tuned in three broadbands by means of easy-to-add dipole arm extensions.

The antenna is statically balanced and equipped with an adapter and mount (AMT-25) which attaches to Tripod TRP-25 or Mast Section MSA-25. Its one-inch diameter rods provide greater surface area, resulting in improved broadband sensitivity.

SPECIFICATIONS

Electrical
Frequency Range: 10 kHz to 30 MHz
Impedance: Matched to 50 ohms
Calibrated Frequency Range:
10 kHz to 30 MHz Antenna Factor
Chart furnished with each antenna
Output Connector: TNC

Mechanical
Outside Diameter: 17"
Height: 20"
Weight: 8 lbs.

GENERAL DESCRIPTION

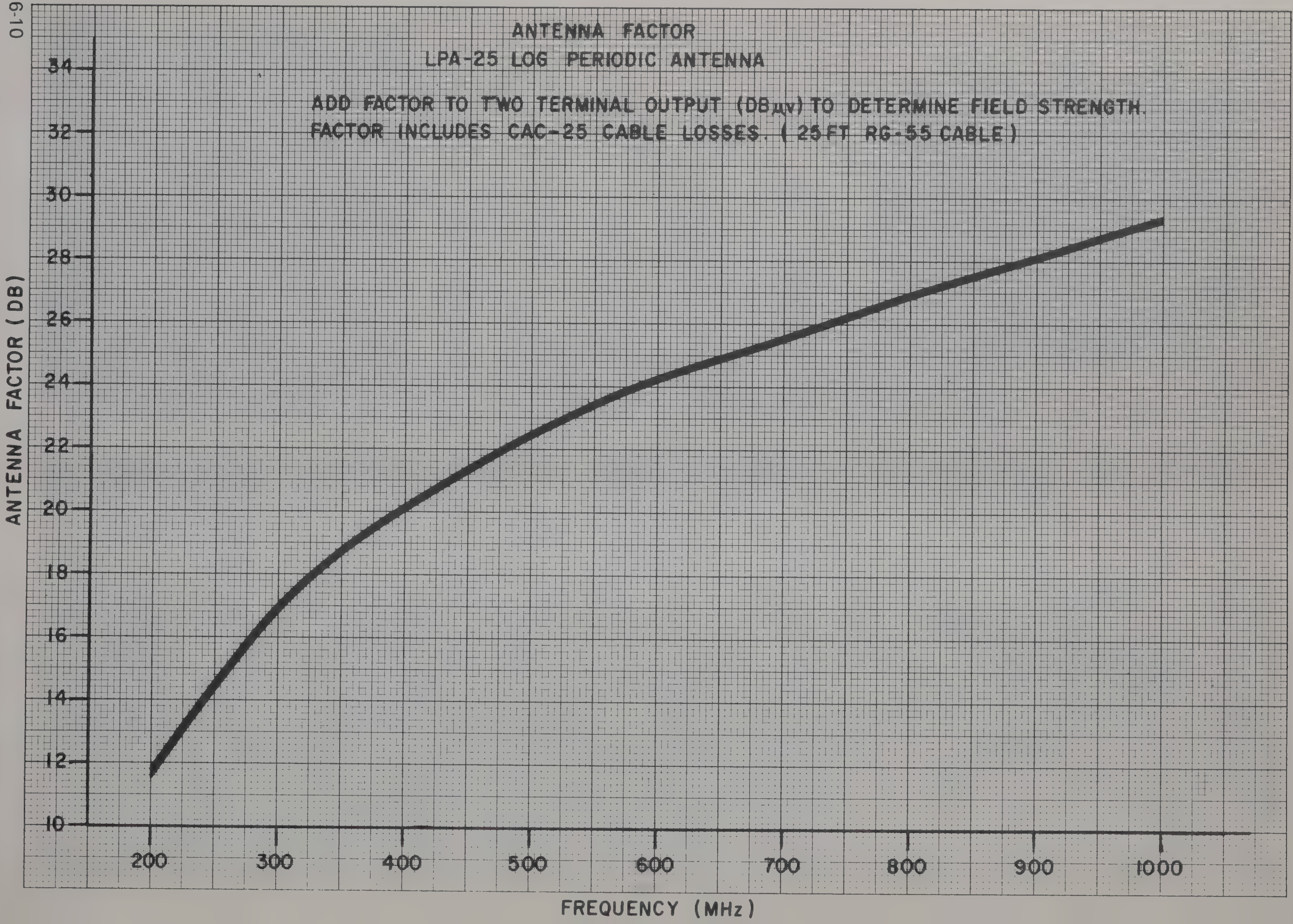
The Loop Antenna Model ALR-25(M), is designed specifically for use with Electro-Metrics Interference Analyzer, EMC-25 or CPR-25 and the ESA-1000. The ALR-25 covers the same frequency range (10 kHz to 30 MHz) as the first ten RF bands of the EMC-25 and CPR-25 plus the ESA-1000 frequency range of 100 kHz to 30 MHz. The matching network is switched for optimum operation at the particular frequency selected.

Model ALR-25(M) is supplied with 25 ft. of RF Cable and frequency ranges are manually selected on the side of the antenna.

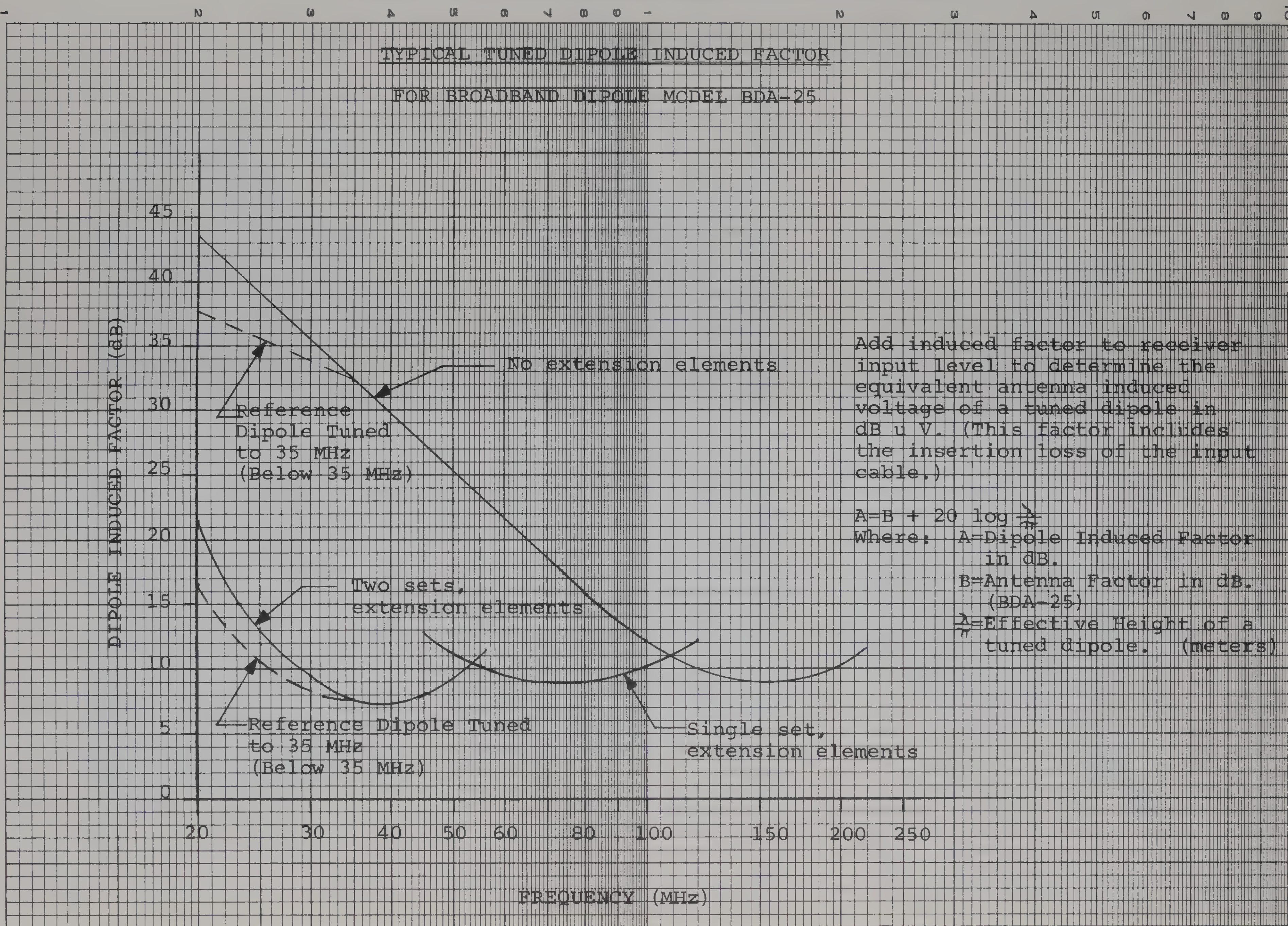
APPLICATION

Model ALR-25(M) uses passive circuits to transform magnetic field components between 10 kHz to 30 MHz to voltage in an EMC-25 – CRP-25 – ESA-1000 50 ohm input system.

TYPICAL ANTENNA FACTOR
LPA-25 LOG PERIODIC ANTENNA

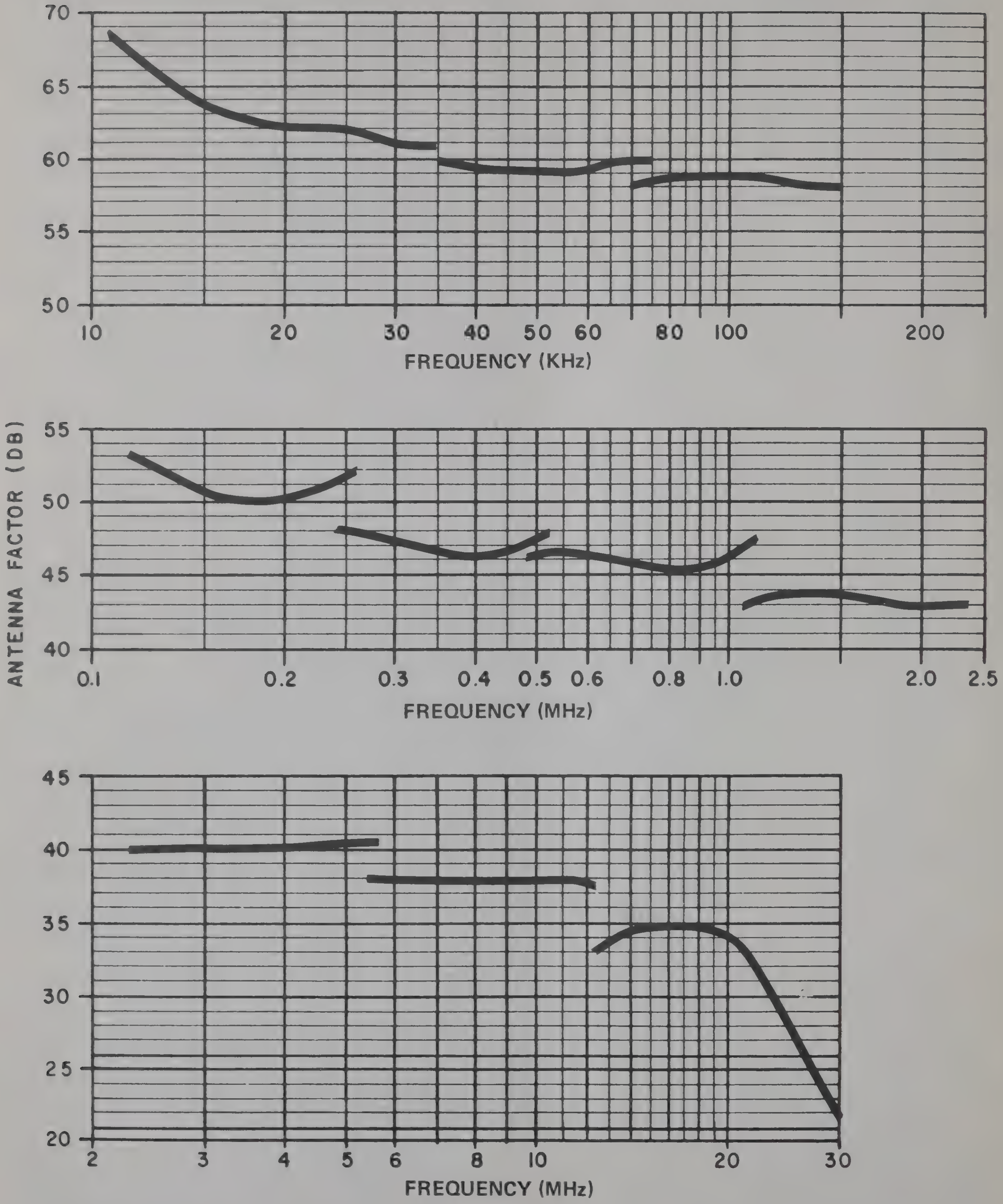


TYPICAL ANTENNA FACTOR, BROADBAND DIPOLE MODEL BDA-25



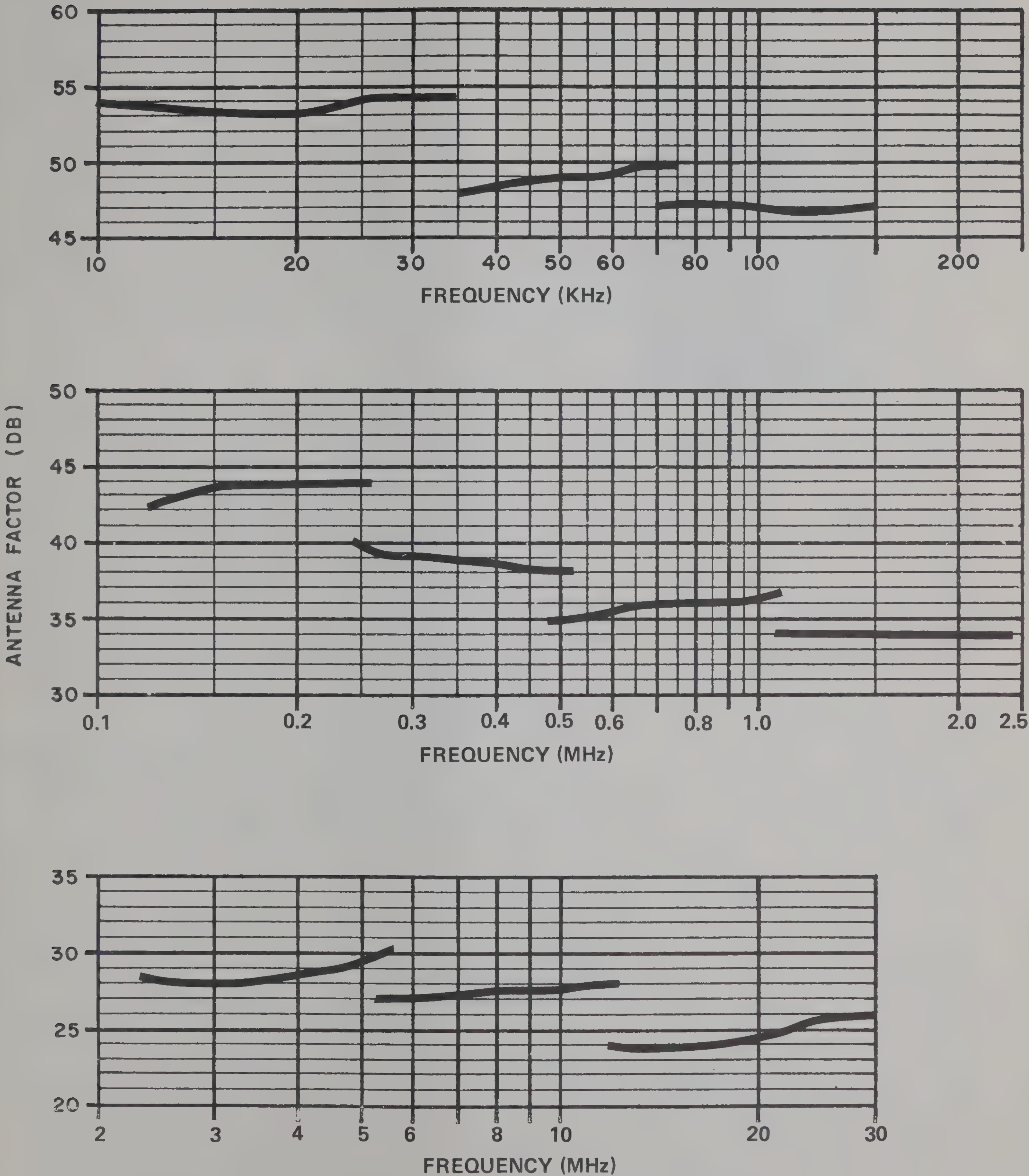
TYPICAL ANTENNA FACTOR CHART

ALR-25



TYPICAL ANTENNA FACTOR CHART

RVR-25



The ALR-25(M) is particularly suited for application in military EMI specification compliance testing such as is outlined in the MIL-STD-826A and MIL-STD-462. This antenna can also be used in power line and the testing of ultra-sonic devices as per FCC dockets. Calibration data and antenna patterns are supplied with each antenna.

RVR-25(M) VERTICAL ANTENNA

SPECIFICATIONS

Electrical
Frequency Range: 10 kHz to 30 MHz
Impedance: Matched to 50 ohms
Calibrated Frequency Range:
10 kHz to 30 MHz Antenna Factor Chart furnished with each antenna
Output Connector: TNC

Mechanical
Antenna Length: 41"
Weight: 7-1/2 lbs.

GENERAL DESCRIPTION

The RVR-25(M) Remote Vertical Antenna is designed specifically for use with Electro-Metrics Interference Analyzer, Model EMC-25 or CPR-25. Model RVR-25(M) covers the same frequency range (10 kHz to 30 MHz) as the first ten RF bands of the EMC-25 and CPR-25 and the ESA-1000 frequency range of 100 kHz to 30 MHz. The matching network is automatically switched for optimum operation at the particular frequency selected.

Model RVR-25(M) is designed for use in conjunction with Counterpoise, Model GPA-25 (which is required for most applications); Tripod, Model TRP-25. Model RVR-25(M) is supplied with 25 ft. of RF Cable and frequency ranges are manually selected on the side of the antenna. The manual version of the rod antenna can be used with receivers and spectrum analyzers having a 50 ohm input impedance.

APPLICATION

The RVR-25(M) Vertical Antenna uses passive circuits to transform electro-static field components to voltage between 10 kHz to 30 MHz (RF Bands 1-10) in an EMC-25 or CPR-25 and 100 kHz to 30 MHz in an ESA-1000 50 ohm input system.

The RVR-25(M) is manufactured particularly for military EMI specification compliance testing in accordance with MIL-STD-826A and MIL-STD-462. This antenna can also be used in the testing of a high voltage power line interference. Calibration data and antenna patterns are supplied with each antenna. Carrying Case available for storage and transportation (LAC-25).

For any additional information/questions concerning the operation of the various accessories with the ESA-1000, contact either ELECTRO-METRICS or its nearest representatives.

SECTION VII
Reference Data

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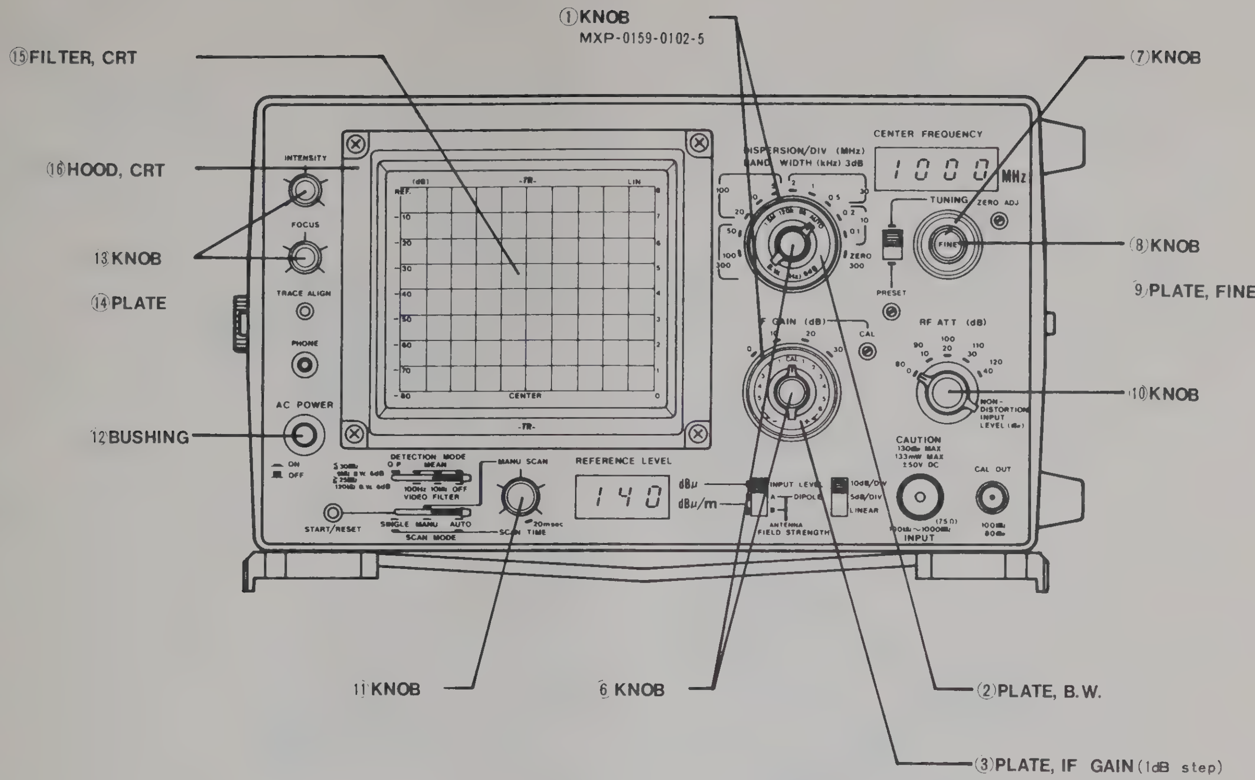


Rotary Switch (S1, SW51) ASSEMBLY

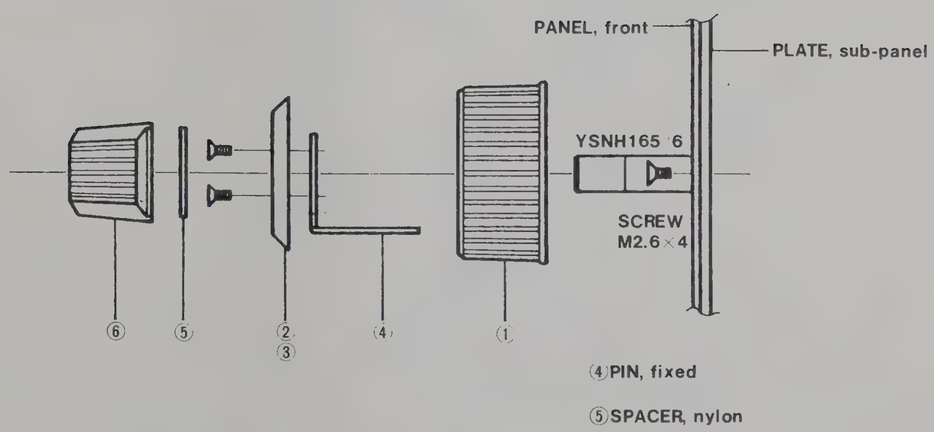


Figure 7.1
ESA-1000 FRONT VIEW

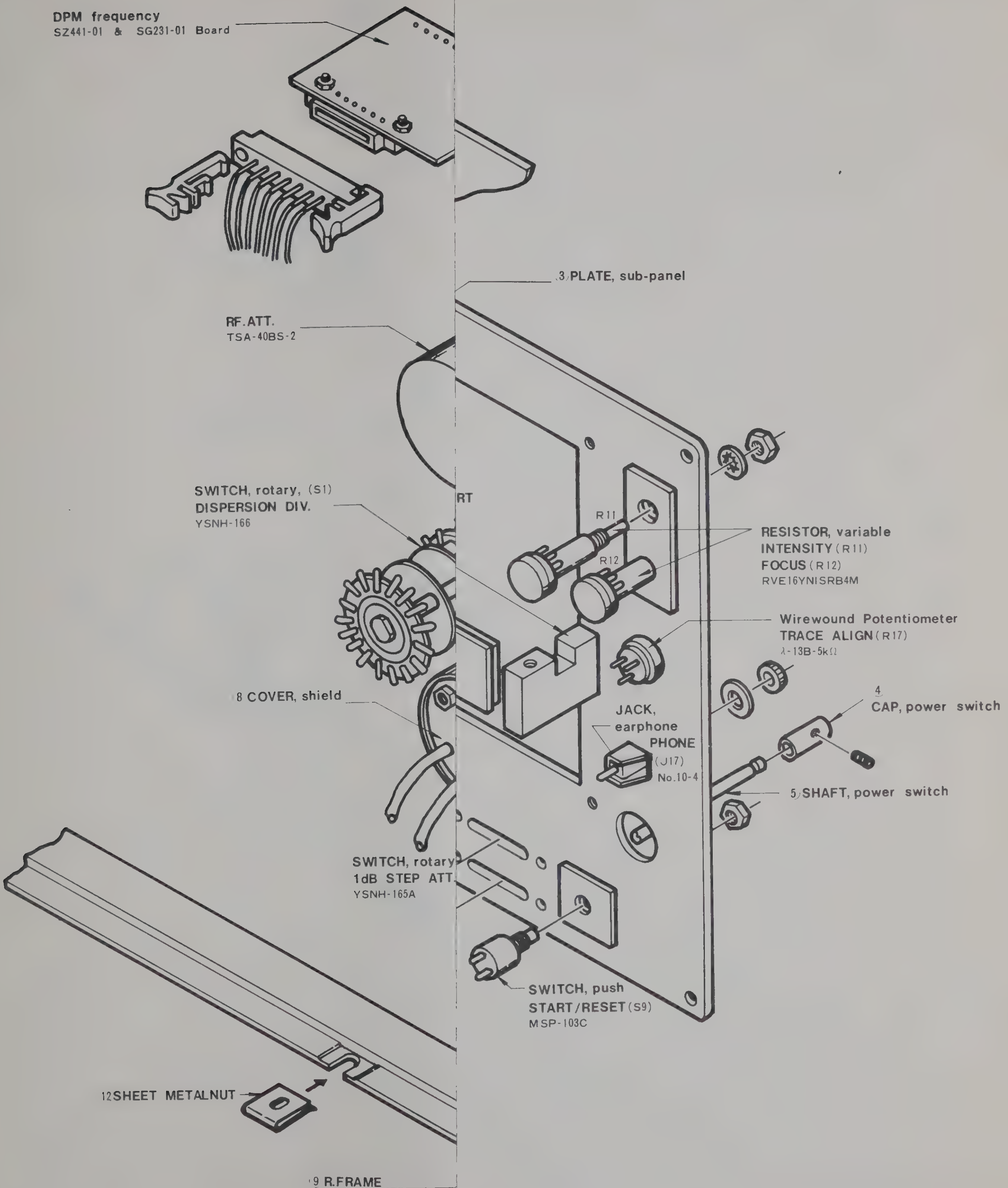


Figure 7.2
ESA-1000 FRONT CHASSIS ASSEMBLY

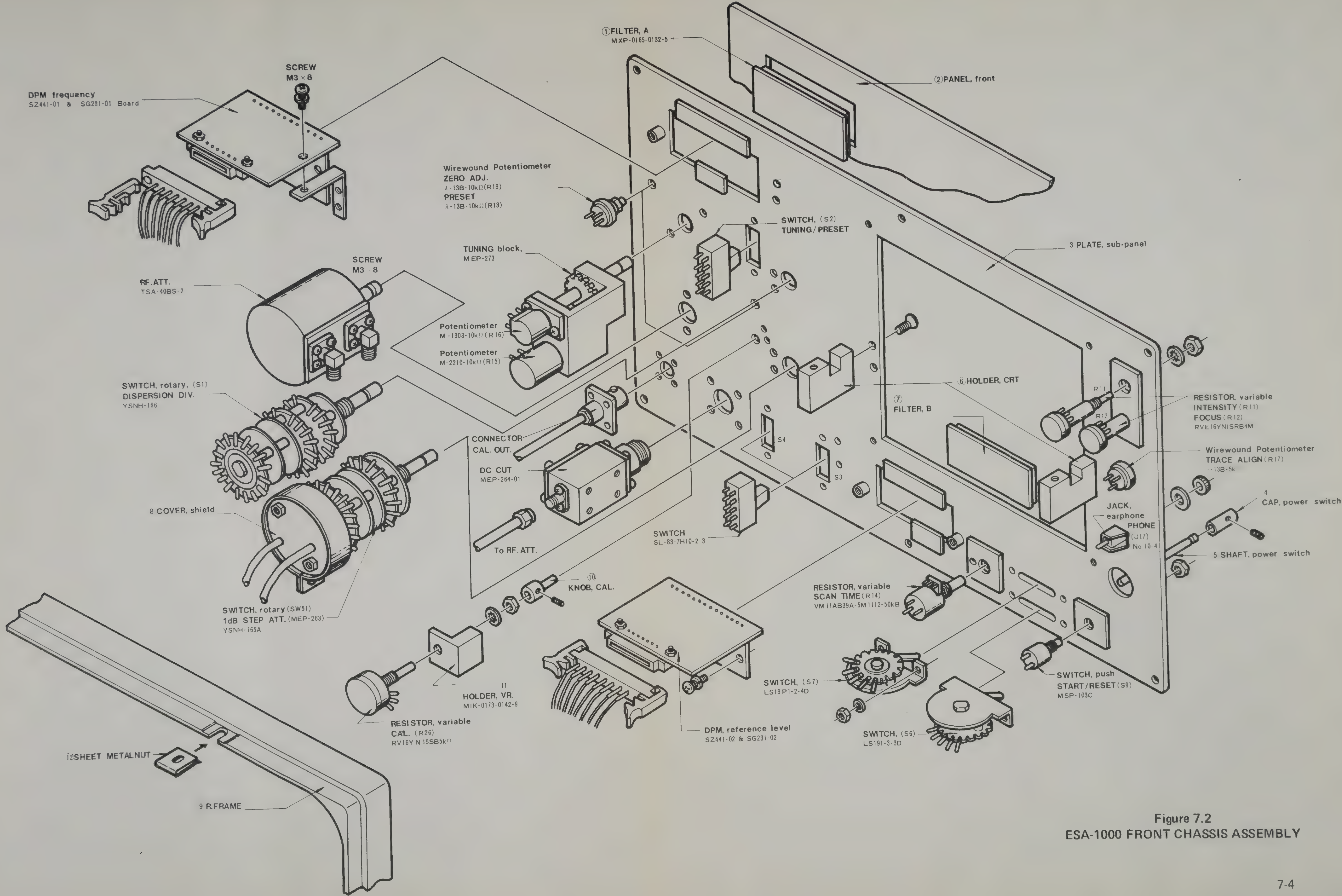


Figure 7.2
ESA-1000 FRONT CHASSIS ASSEMBLY

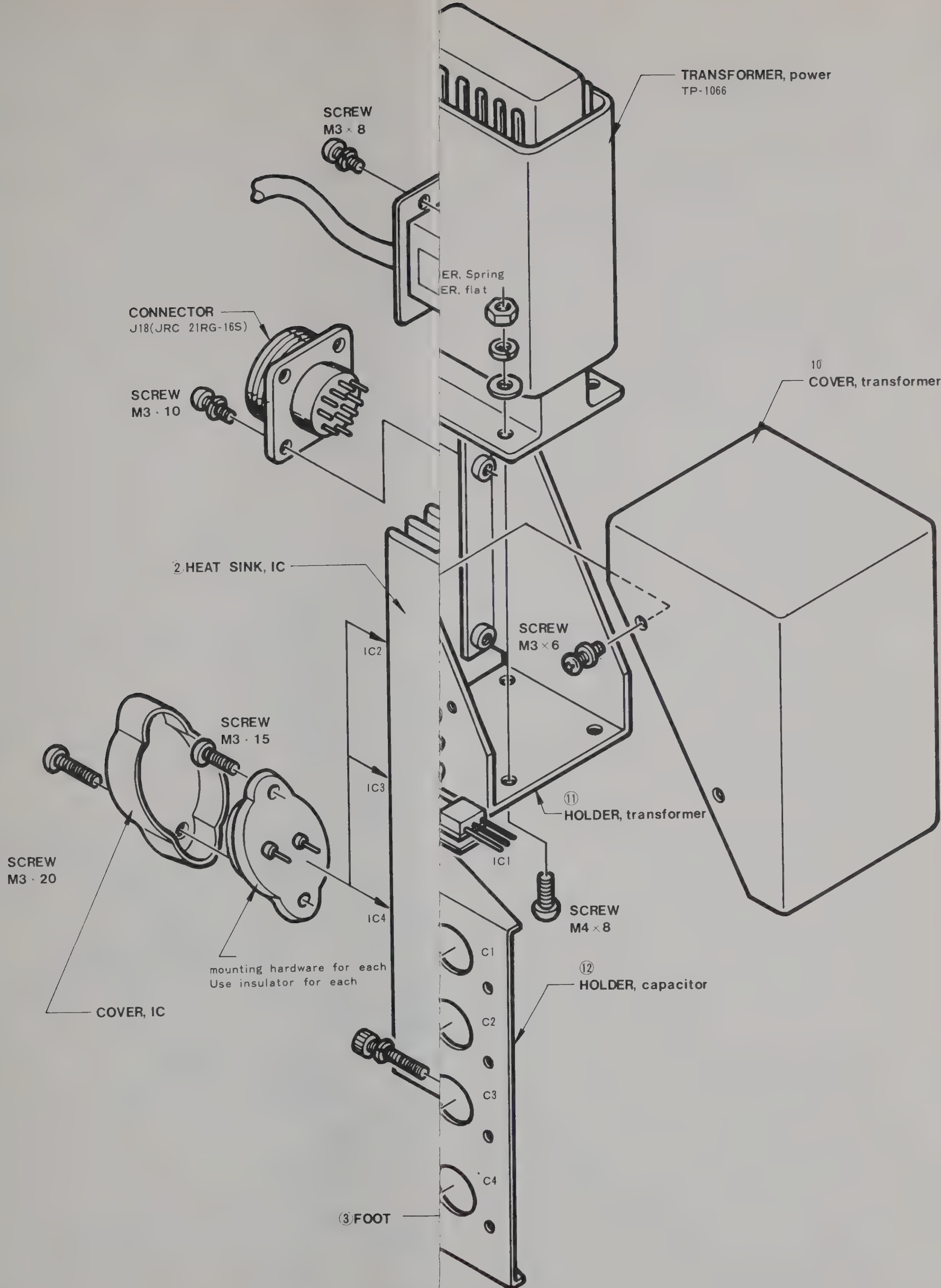


Figure 7.3
ESA-1000 REAR CHASSIS ASSEMBLY

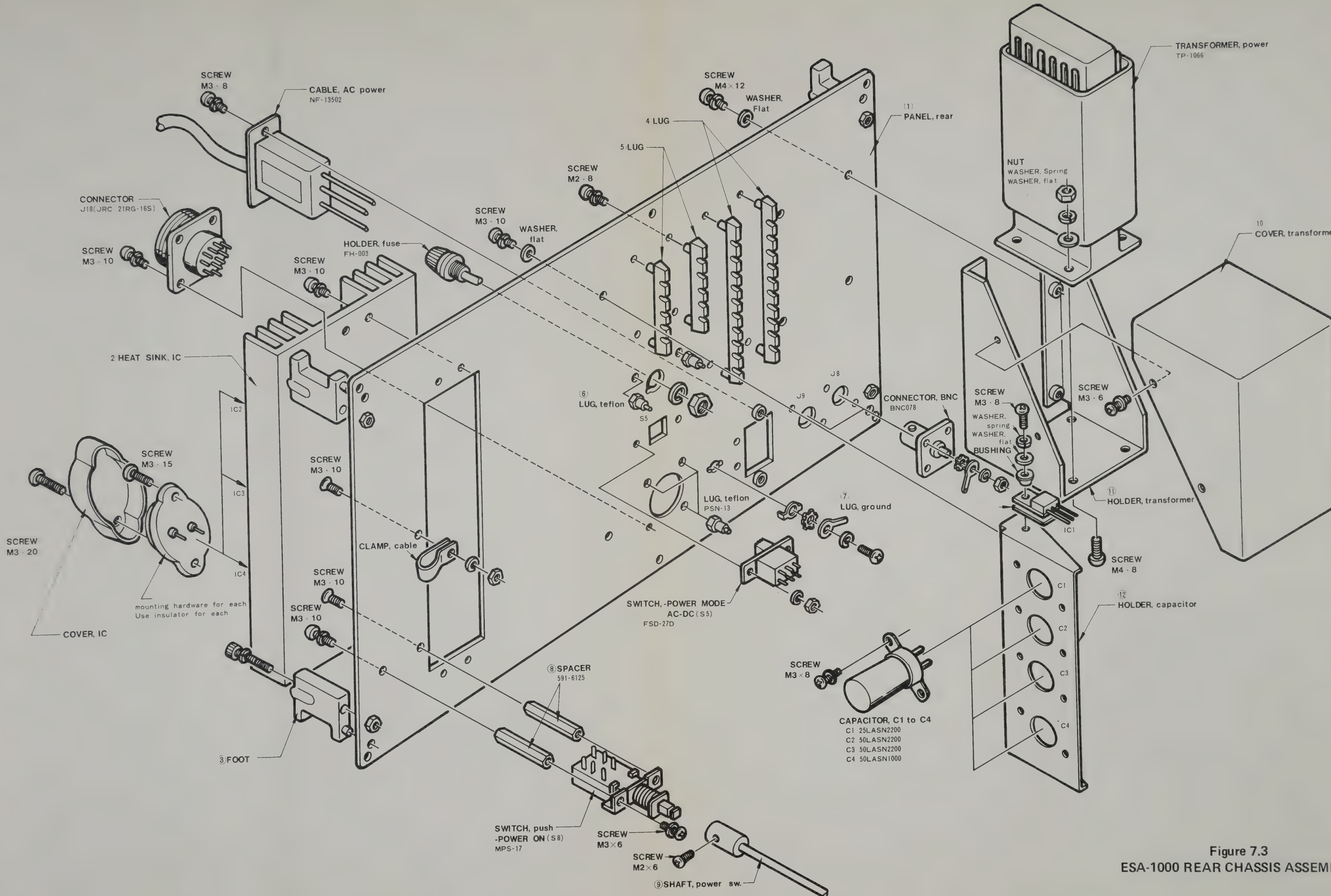


Figure 7.3
ESA-1000 REAR CHASSIS ASSEMBLY

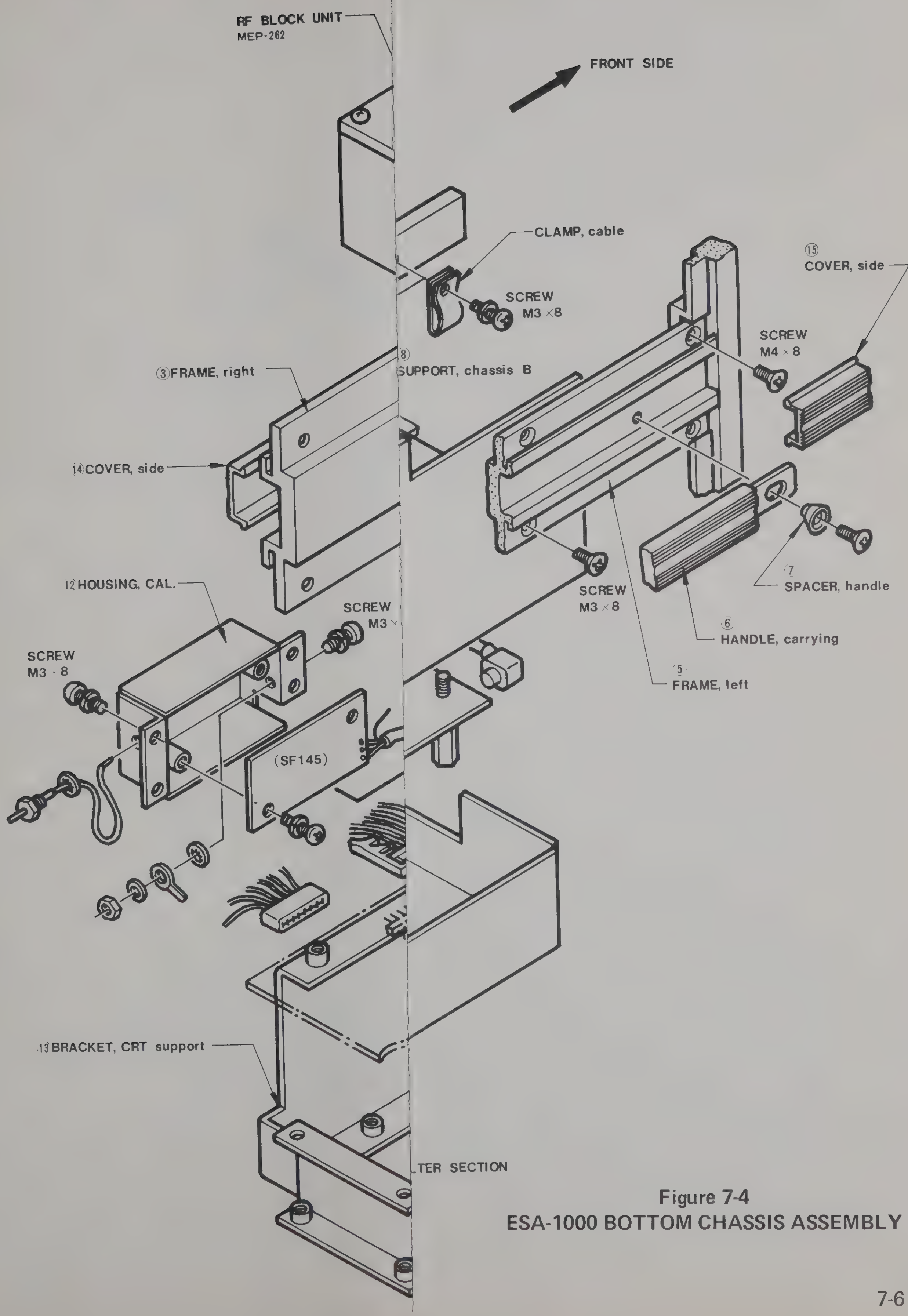


Figure 7-4
ESA-1000 BOTTOM CHASSIS ASSEMBLY

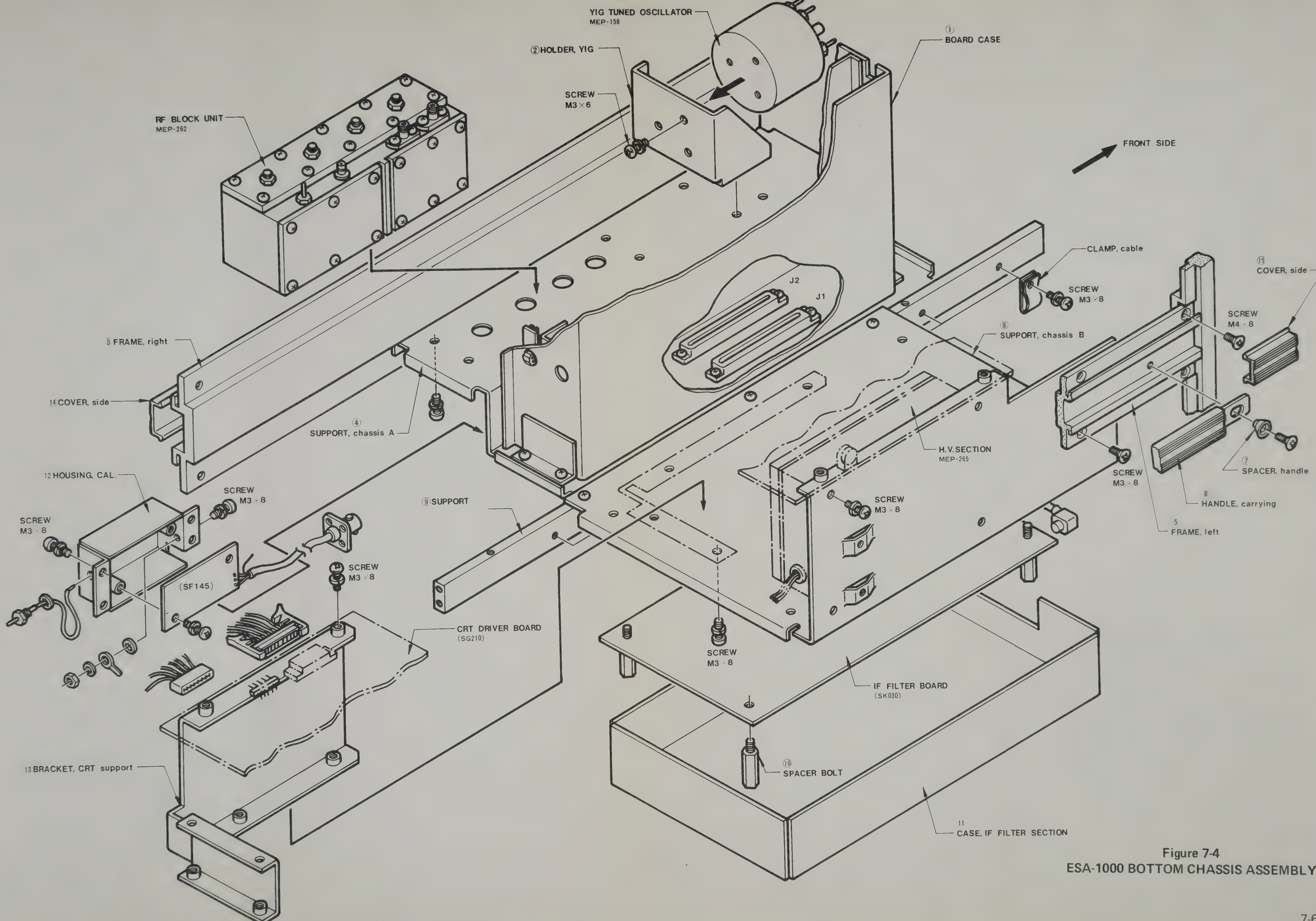


Figure 7-4
ESA-1000 BOTTOM CHASSIS ASSEMBLY

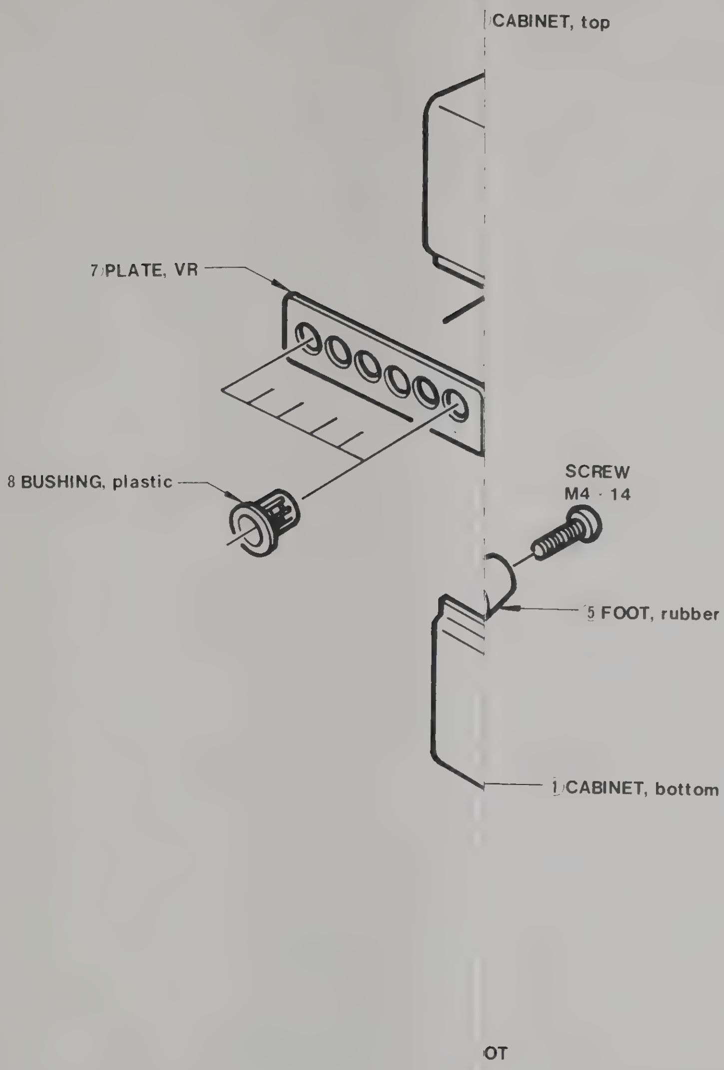


Figure 7.5
ESA-1000 COVERS ASSEMBLY

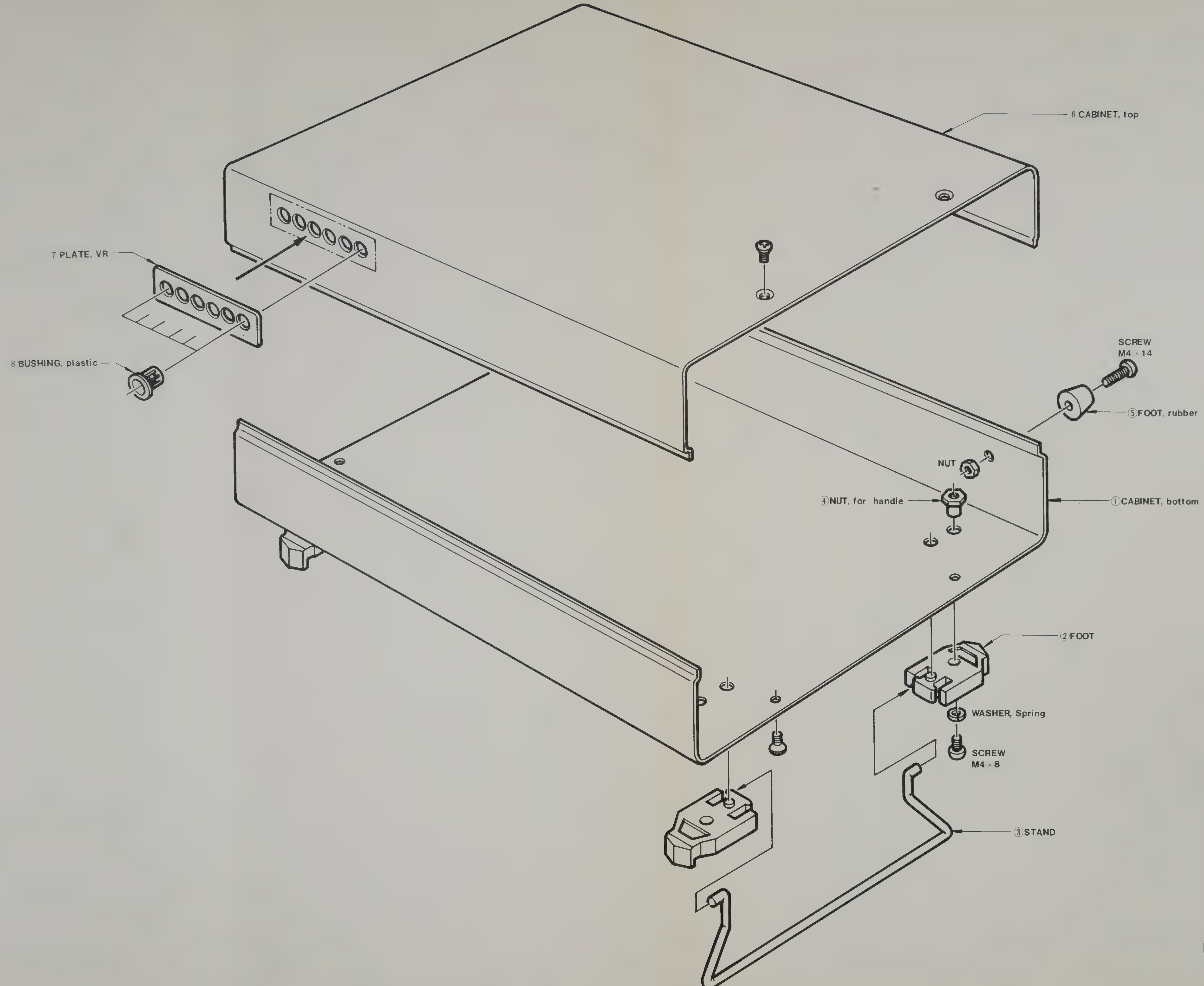
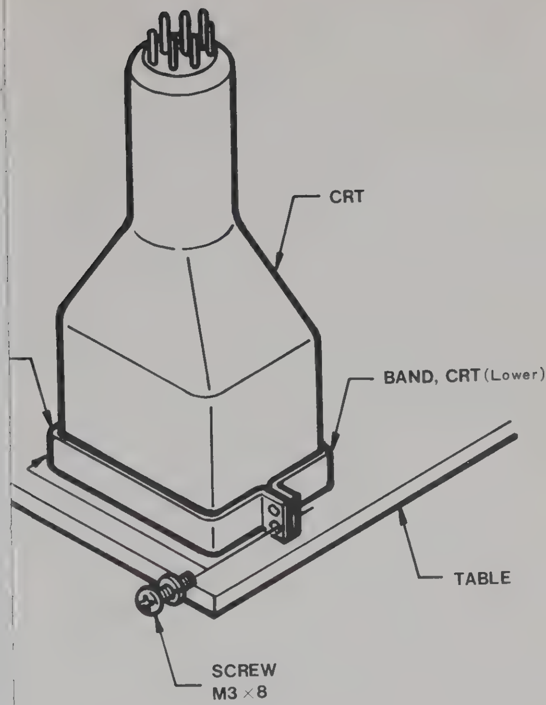


Figure 7.5
ESA-1000 COVERS ASSEMBLY



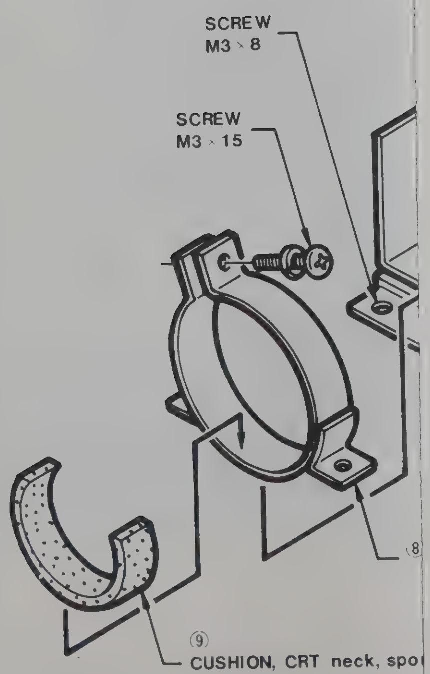
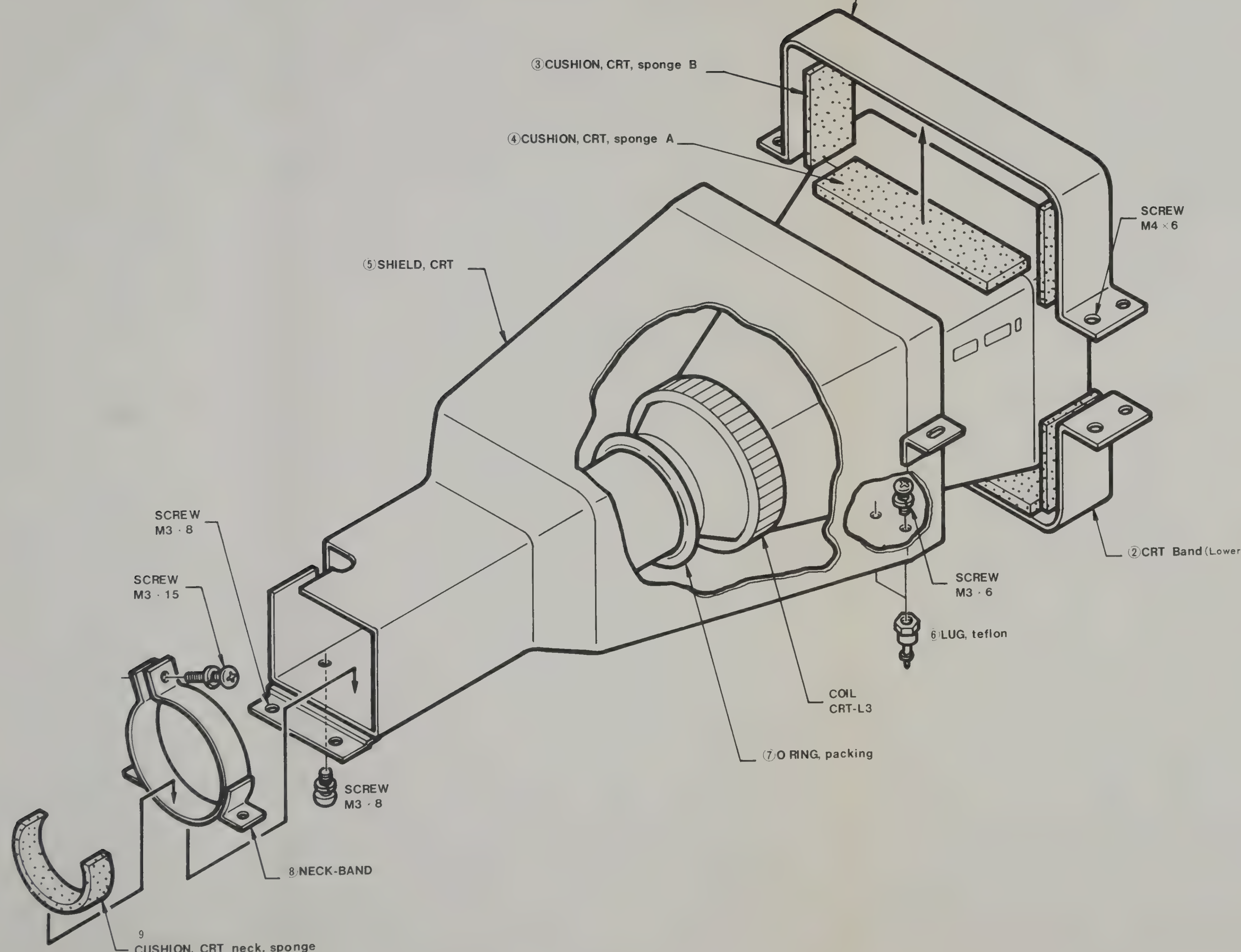


Figure 7.6
ESA-1000 CRT & SHIELD ASSEMBLY



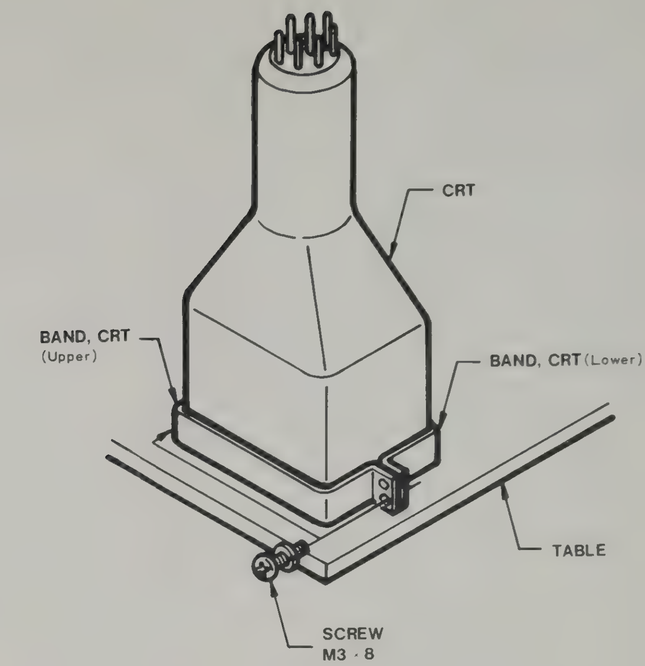


Figure 7.6
ESA-1000 CRT & SHIELD ASSEMBLY

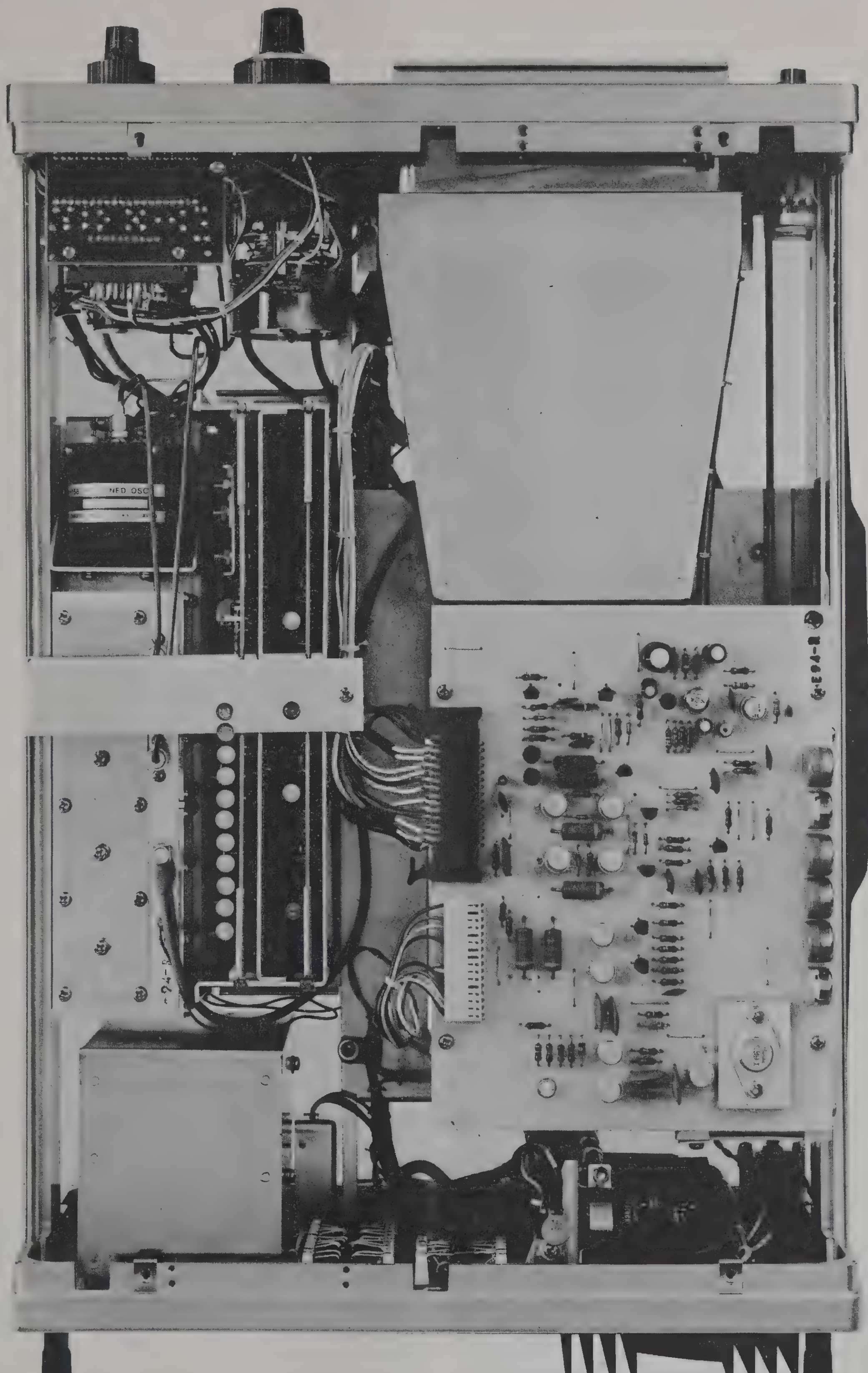
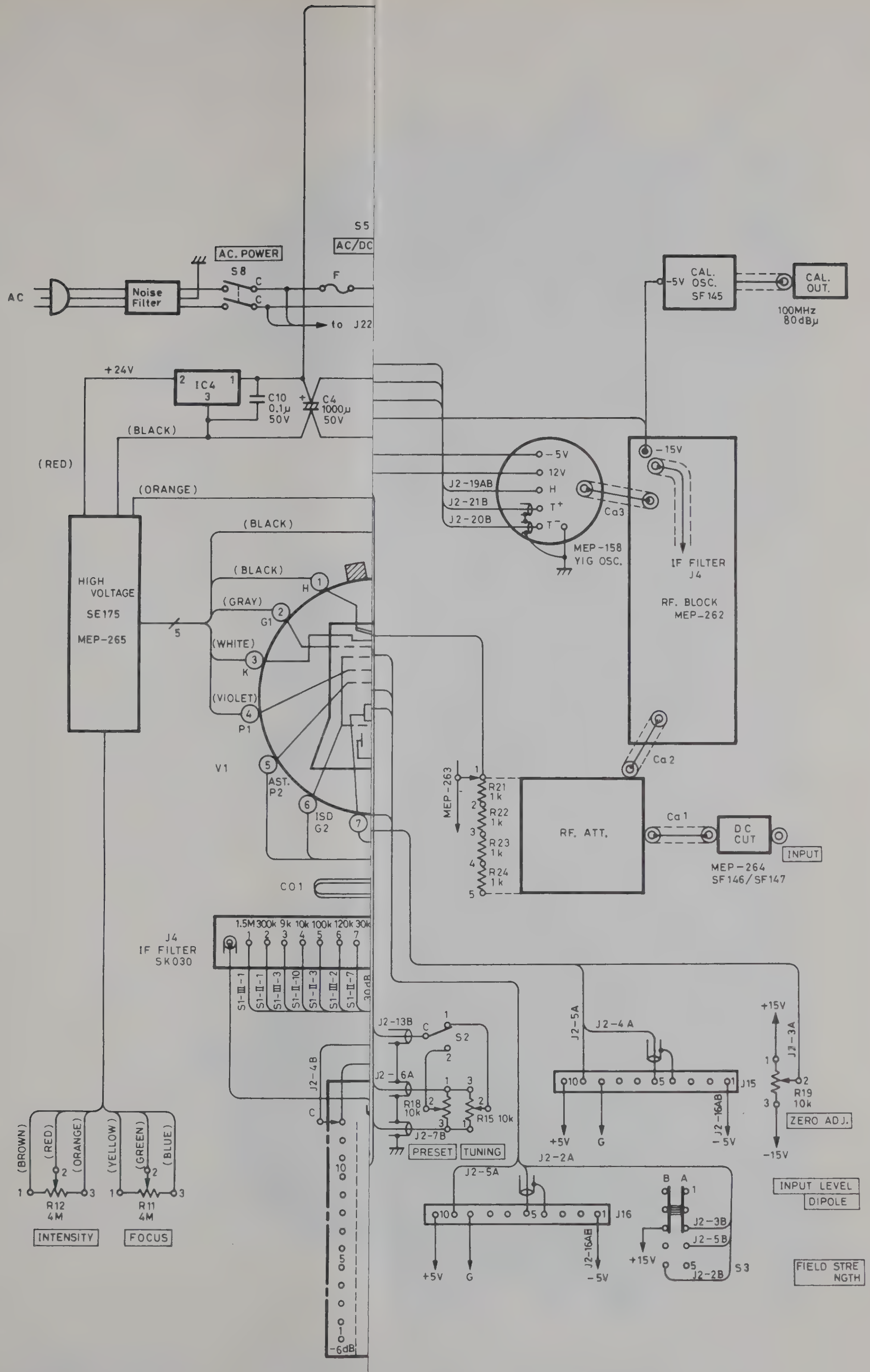


Figure 7.7 ESA-1000 TOP VIEW



0395906-001-D

Figure 7.8
CONTROL SECTION

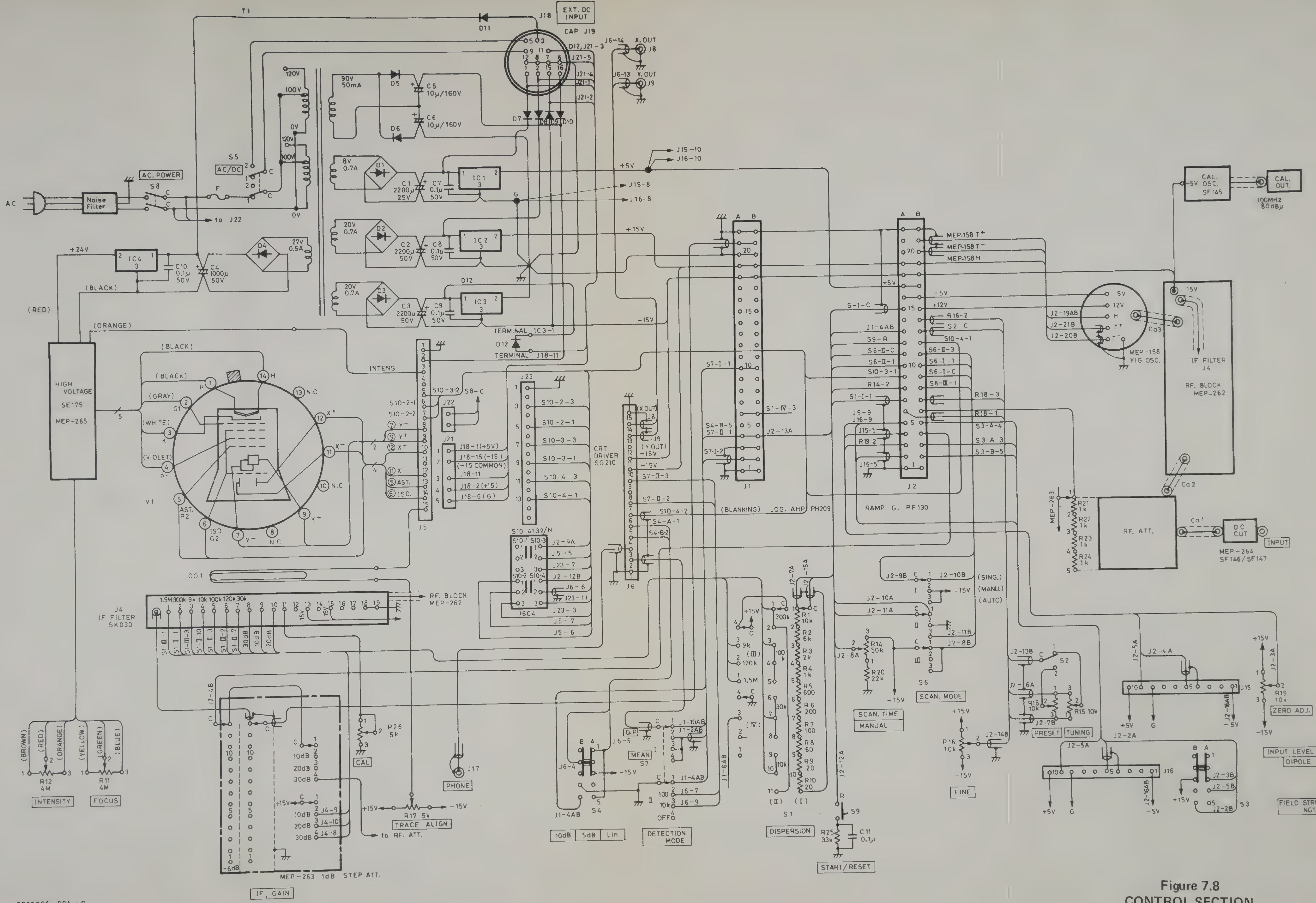
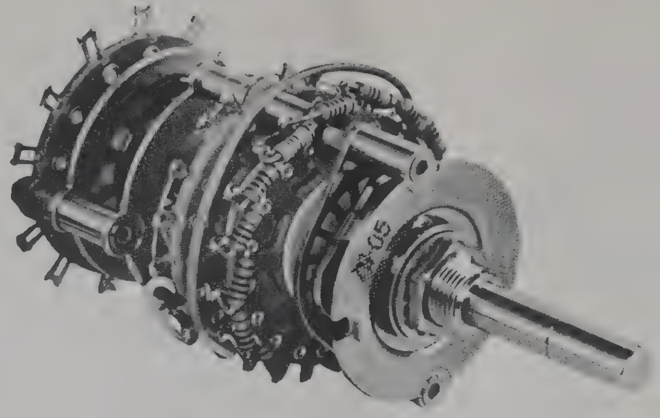
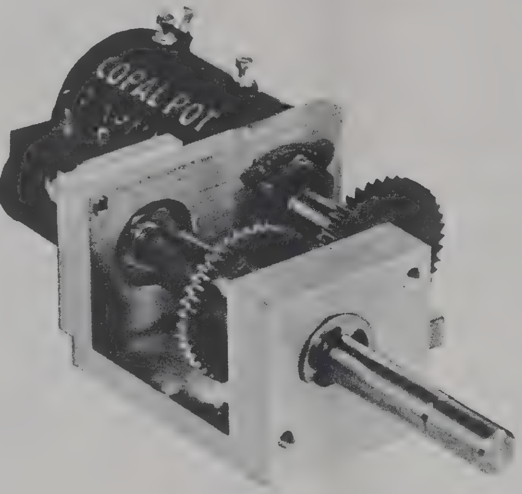


Figure 7.8
CONTROL SECTION

Rotary Switch (S1)
DISPERSION/DIV.
(YSNH−166)



TUNING BLOCK
(MEP−273)



RF.ATT.
(TSA−40BS−2)

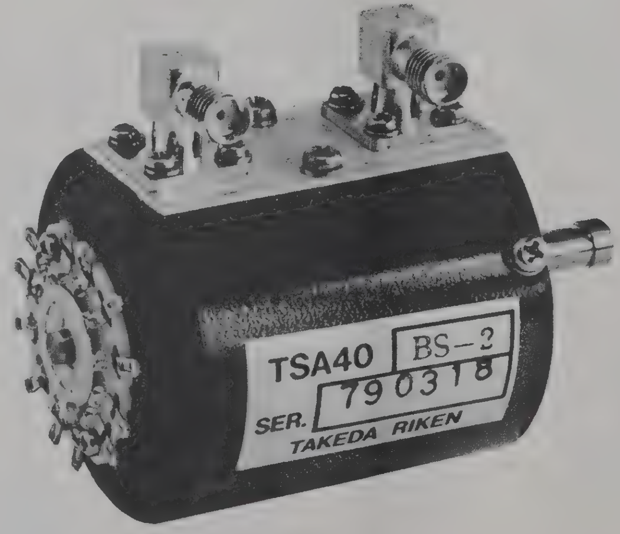
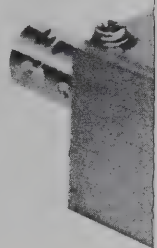


Figure 7.10 ROTARY SWITCH, RF TUNING BLOCK, RF ATTENUATOR ASSEMBLIES



DC BI

Figure 7.11

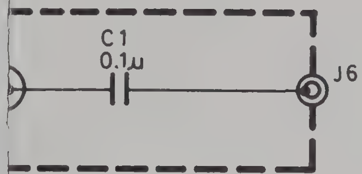


Figure 7.12
DC BLOCKING CKT
MEP-264-01

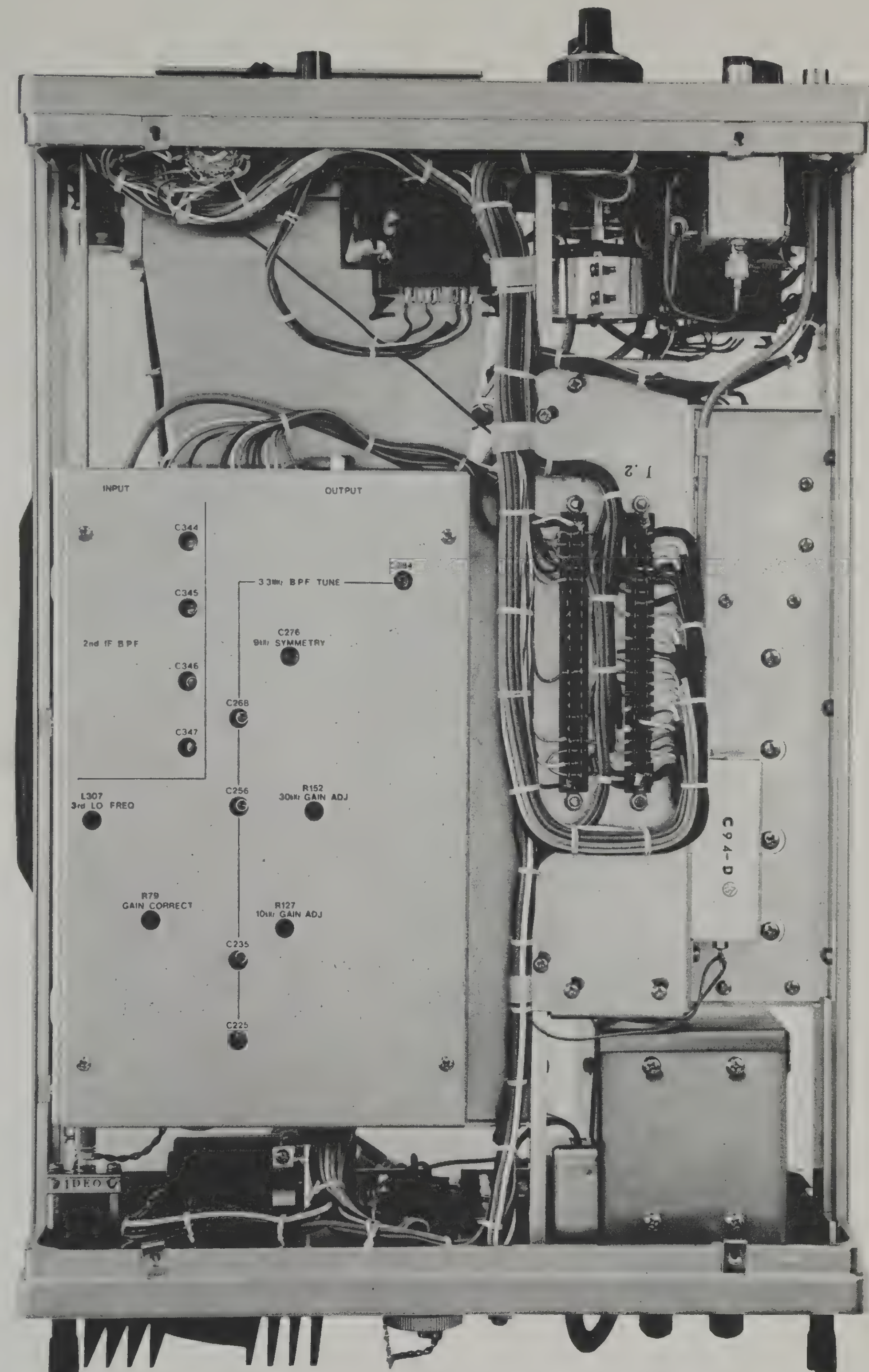


Figure 7.9 ESA-1000 BOTTOM VIEW

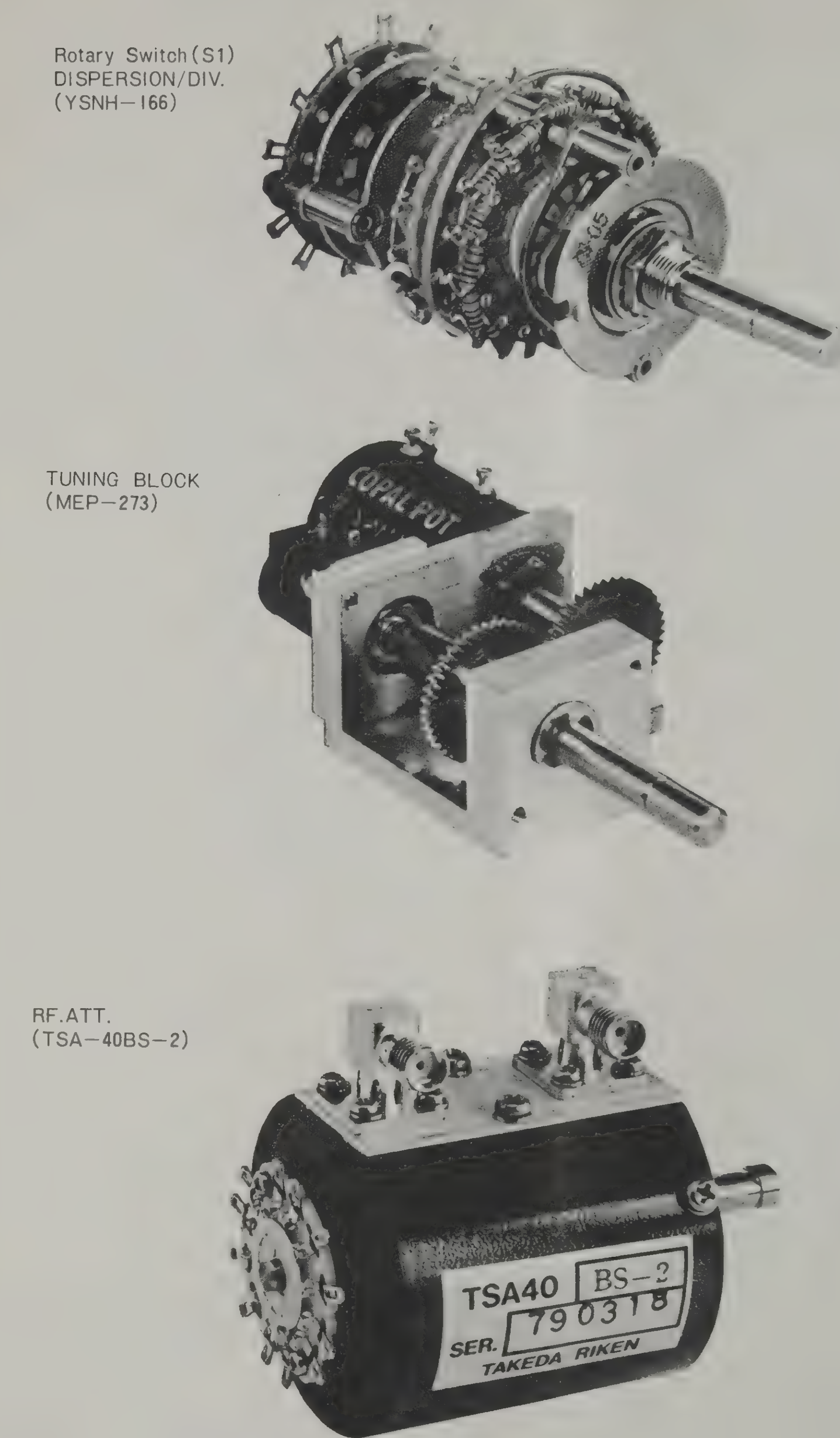
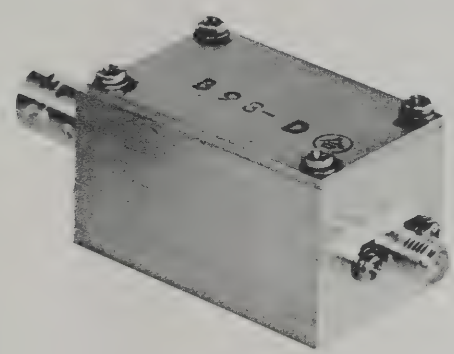
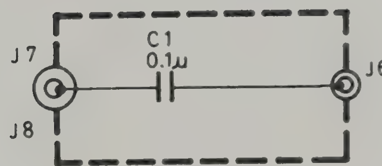


Figure 7.10 ROTARY SWITCH, RF TUNING BLOCK, RF ATTENUATOR ASSEMBLIES



DC BLOCKING ASSEMBLY
MEP-264-01/02

Figure 7.11 DC BLOCKING ASSEMBLY



0395906 – 003 – B

Figure 7.12
DC BLOCKING CKT
MEP-264-01

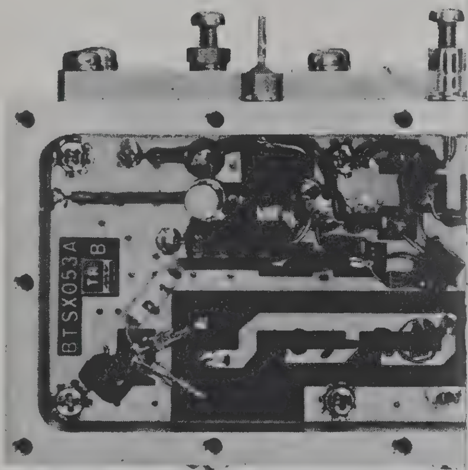


Figure 7.13 1

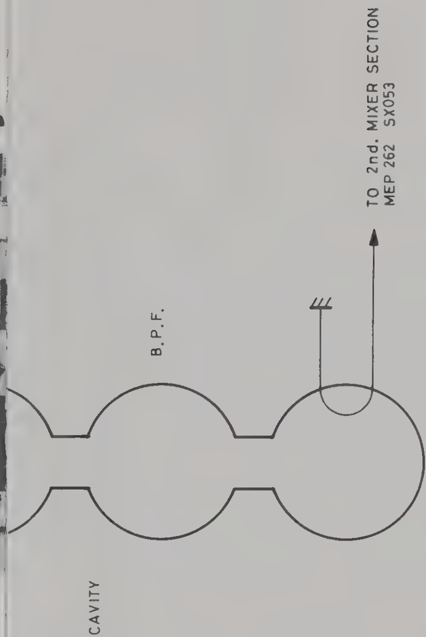


Figure 7.14
1ST MIXER CIRCUIT

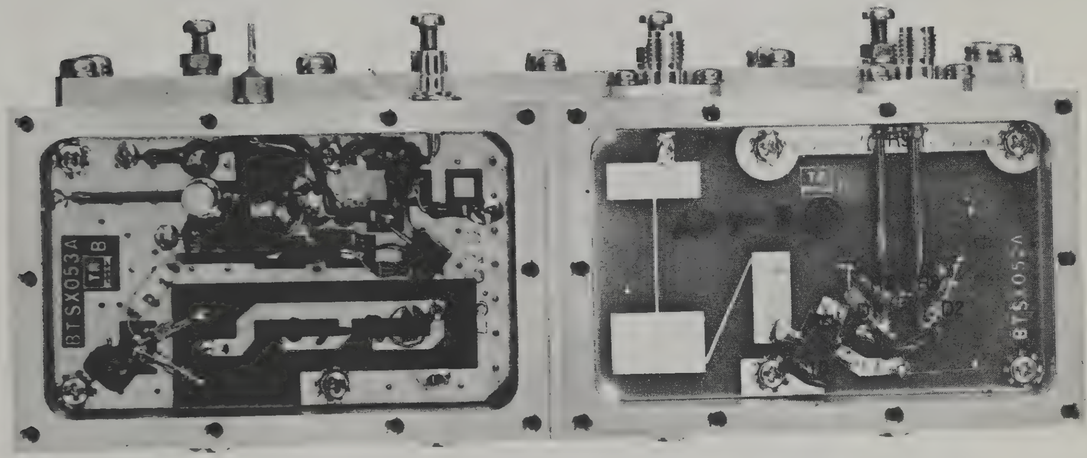


Figure 7.13 1ST MIXER ASSEMBLY (SX052)

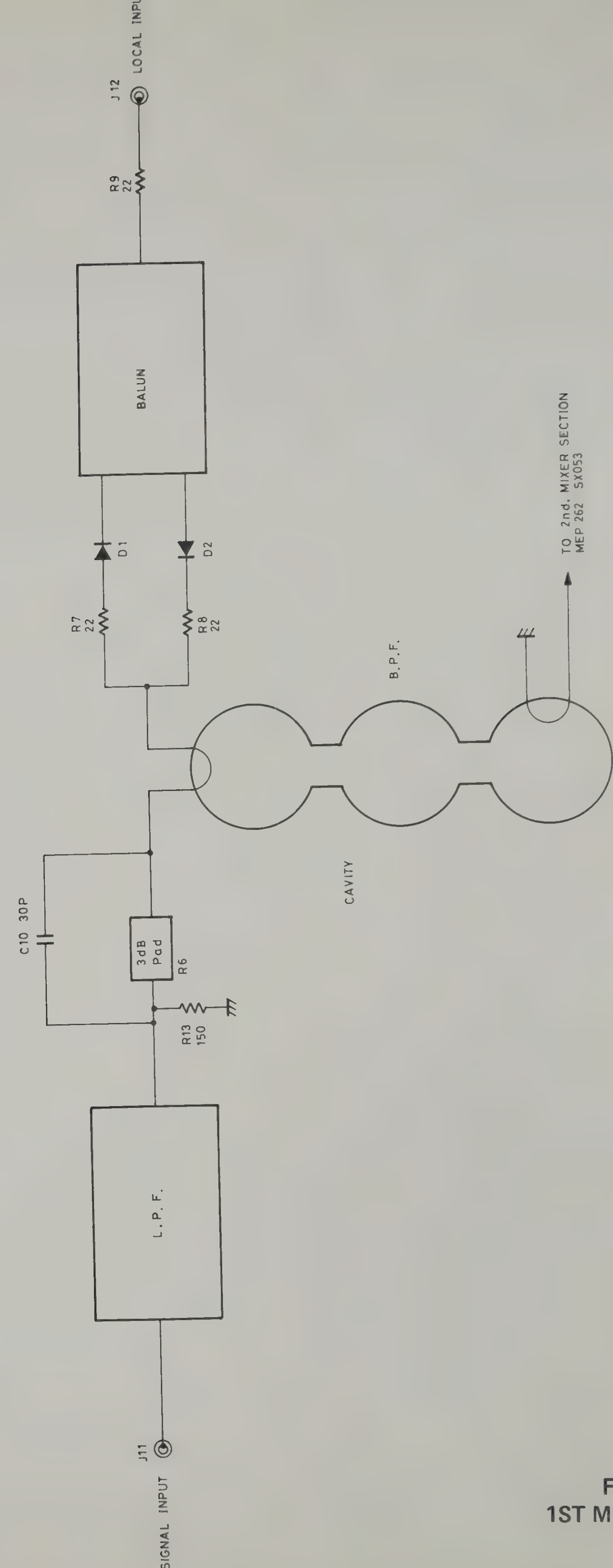


Figure 7.14
1ST MIXER CIRCUIT

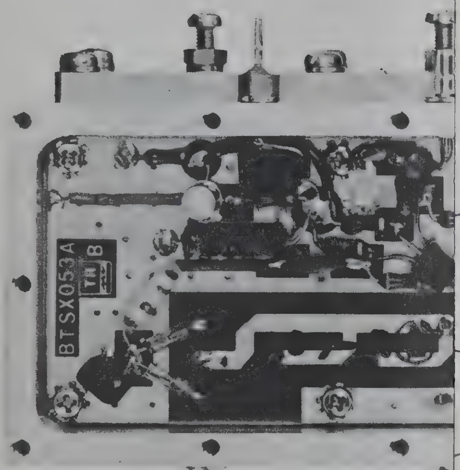


Figure 7.15 2

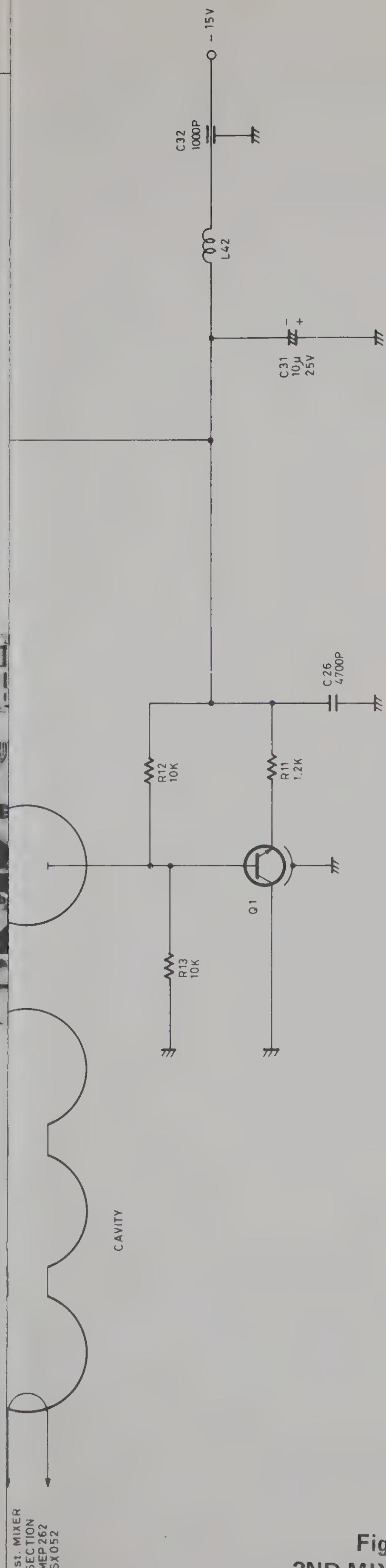


Figure 7.16
2ND MIXER CIRCUIT

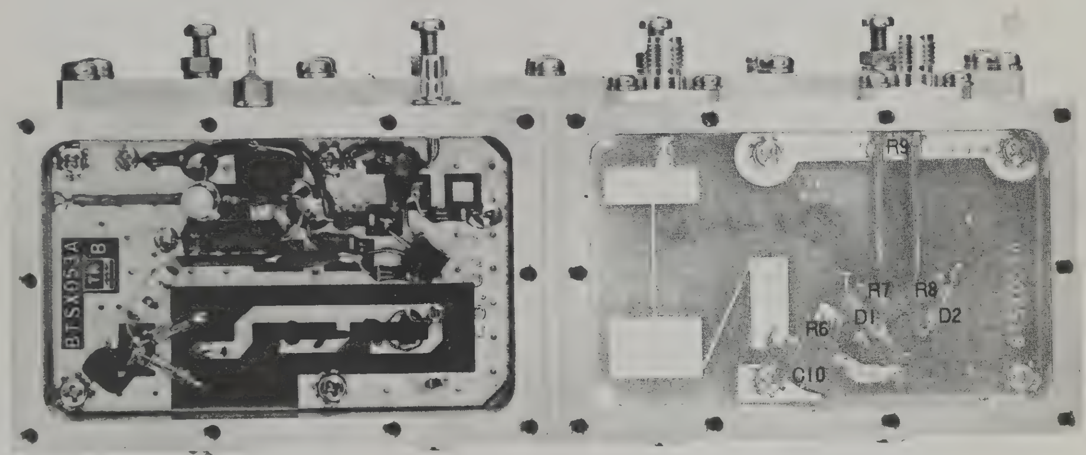


Figure 7.15 2ND MIXER ASSEMBLY (SX053)

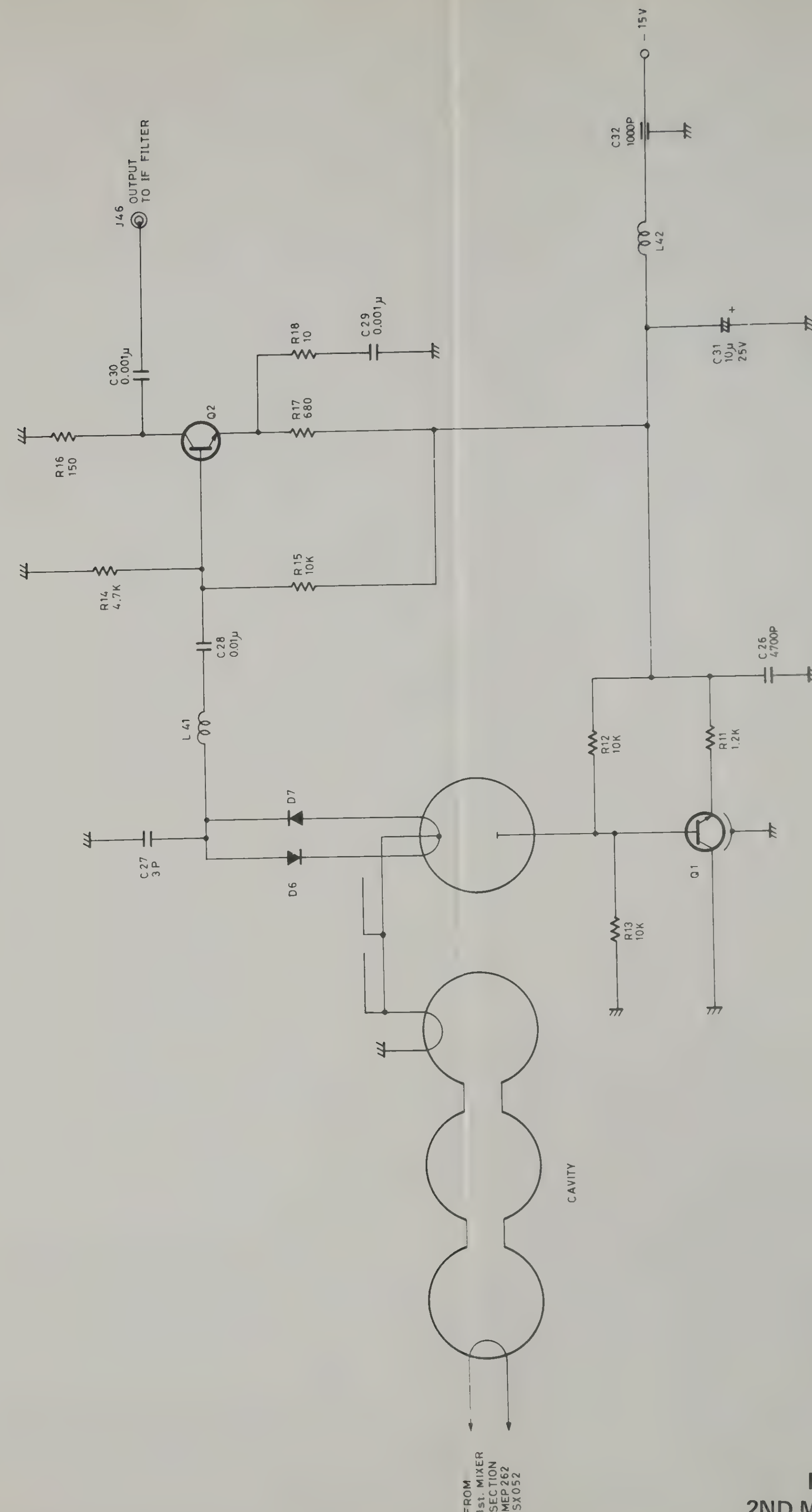


Figure 7.16
2ND MIXER CIRCUIT

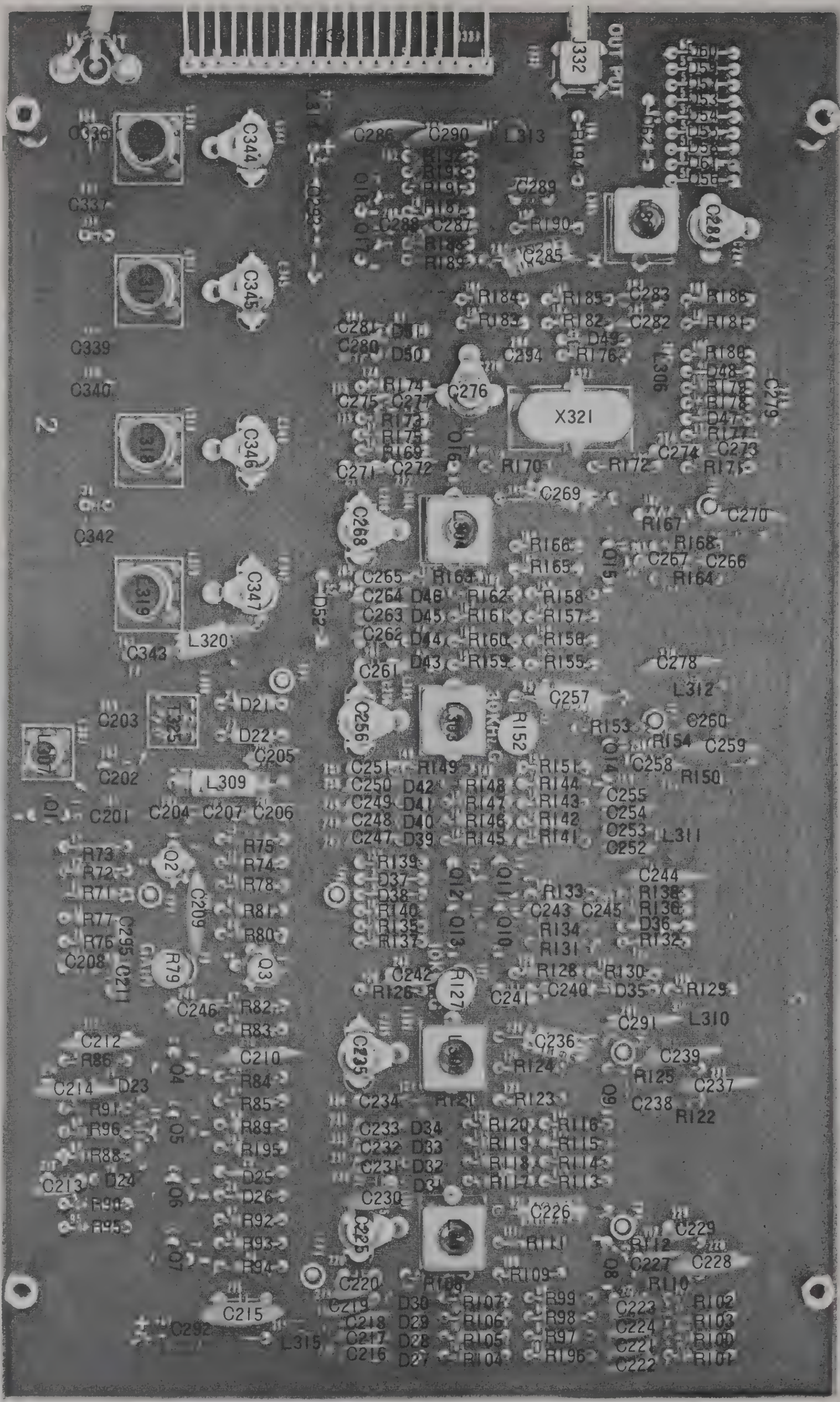
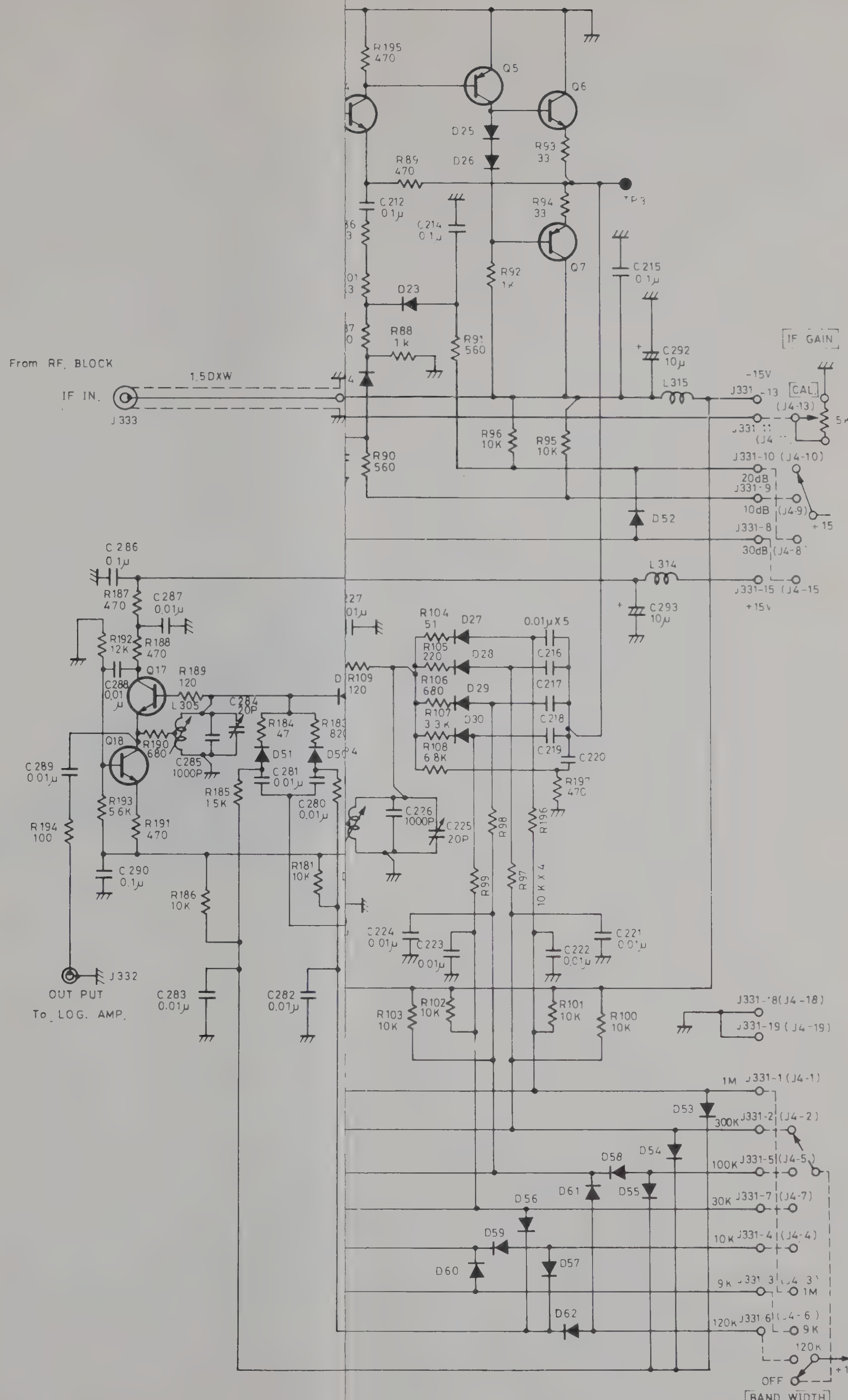


Figure 7.17 IF FILTER Bd LAYOUT (SK030)



0395906 - 006 - C

Figure 7.18
IF FILTER CIRCUIT

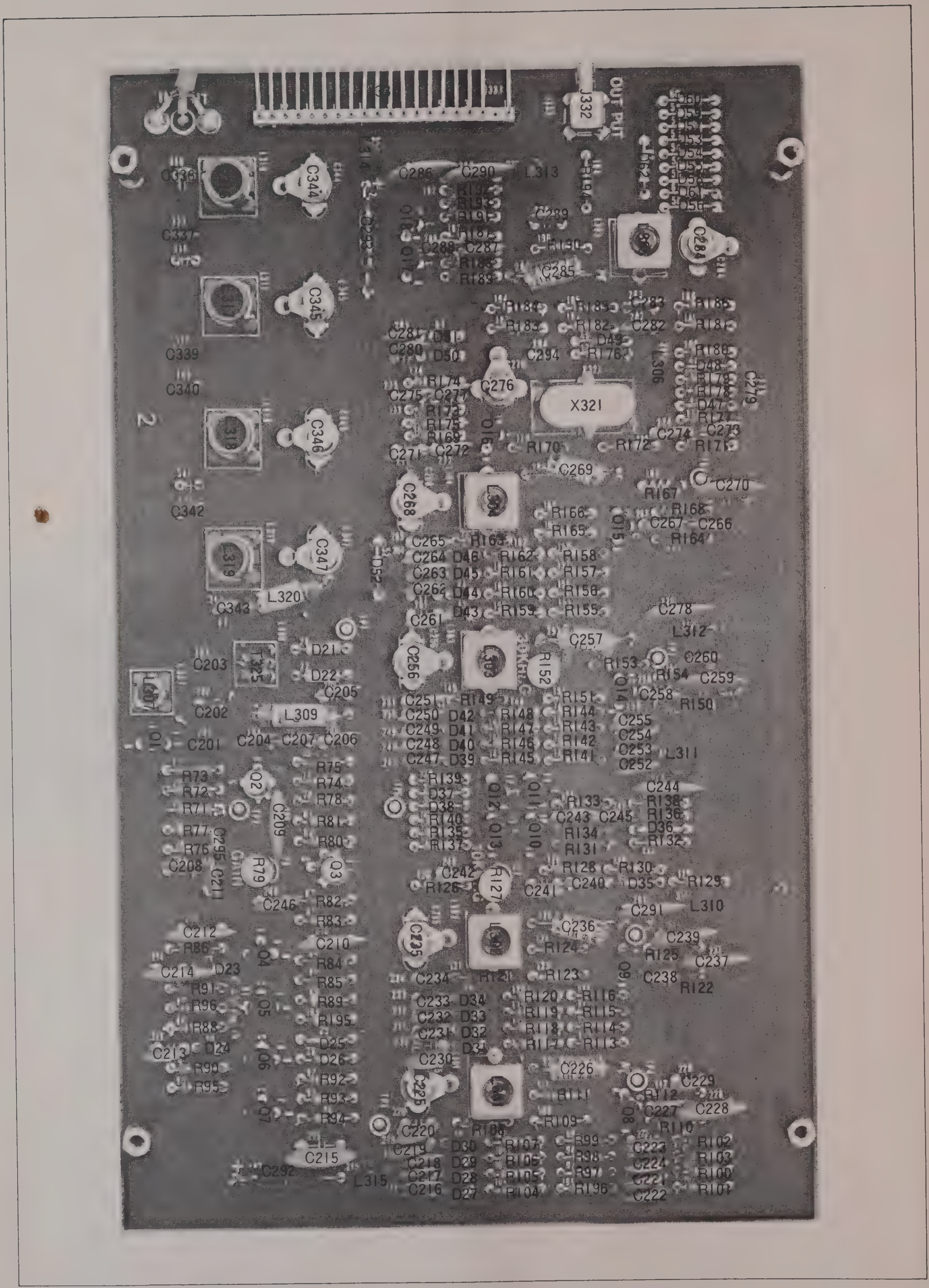
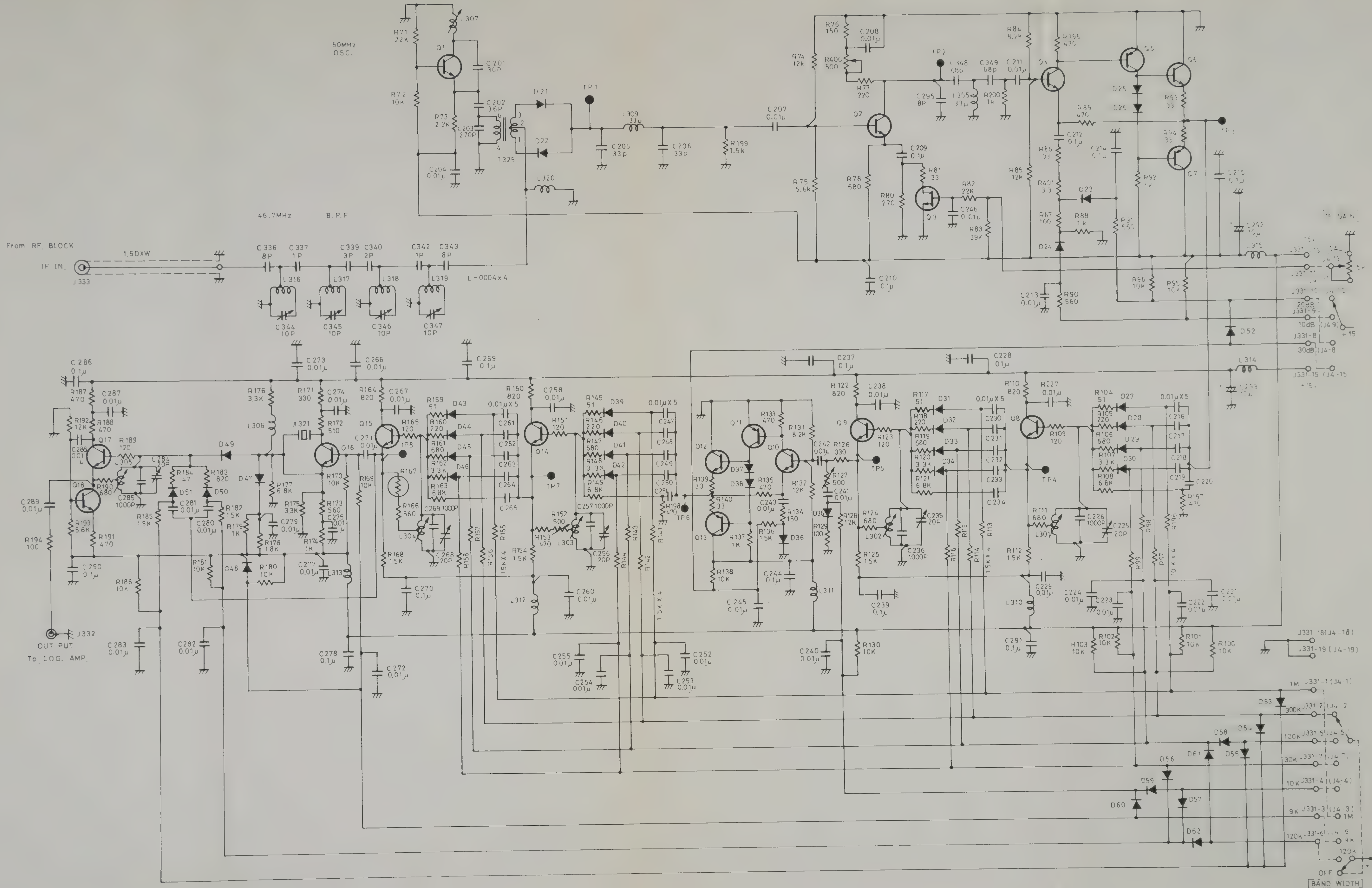


Figure 7.17 IF FILTER Bd LAYOUT (SK030)



0395906-006-C

Figure 7.18
IF FILTER CIRCUIT

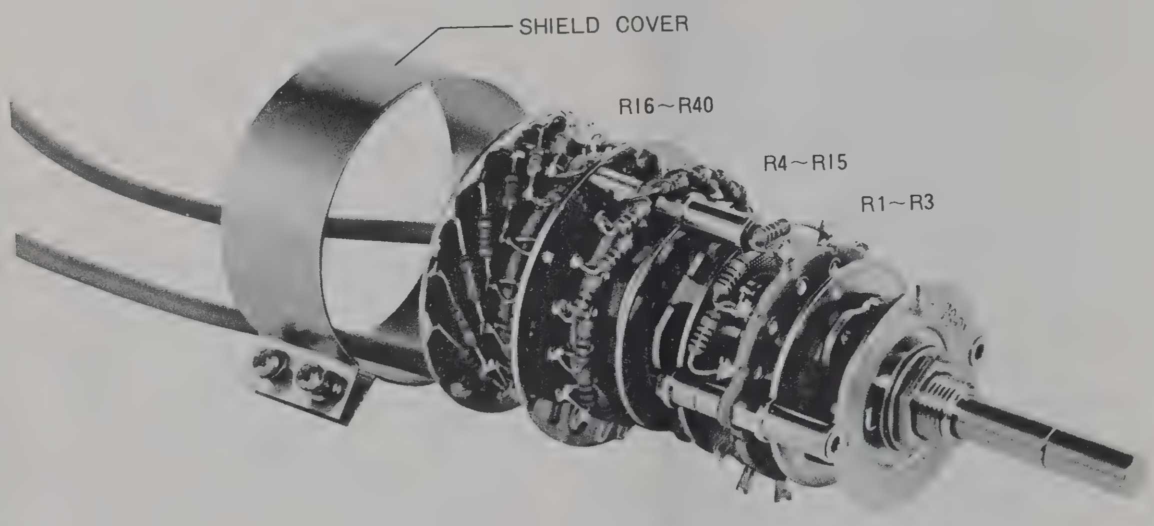
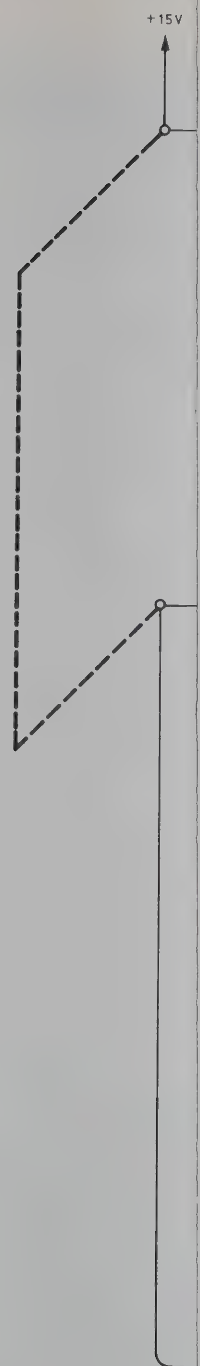


Figure 7.19 1 dB STEP ATTENUATOR SWITCH ASSEMBLY (MEP-263)



0395906-007-A

Figure 7.20
1 dB STEP ATTENUATOR CIRCUIT

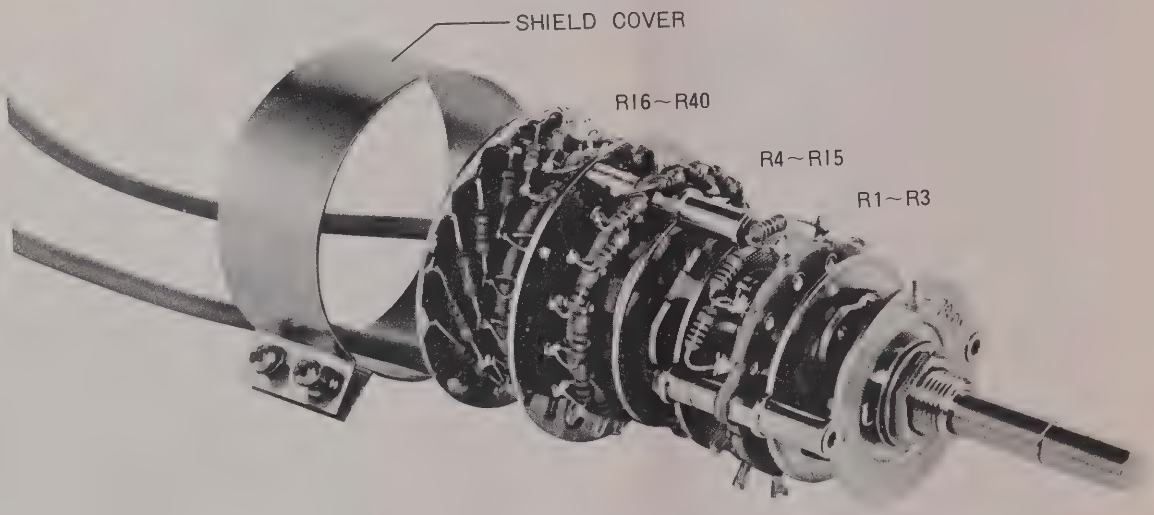


Figure 7.19 1 dB STEP ATTENUATOR SWITCH ASSEMBLY (MEP-263)

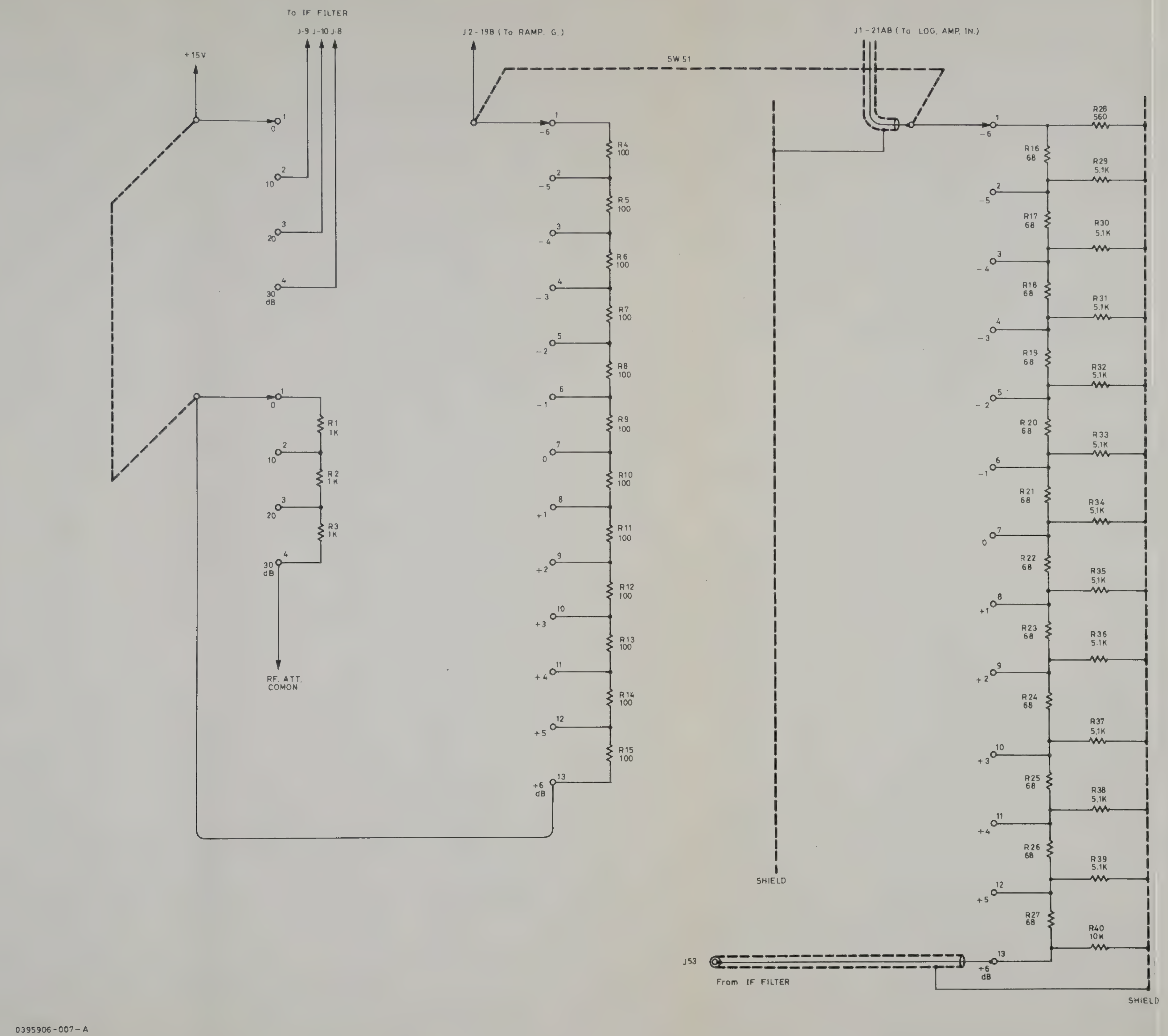


Figure 7.20
1 dB STEP ATTENUATOR CIRCUIT

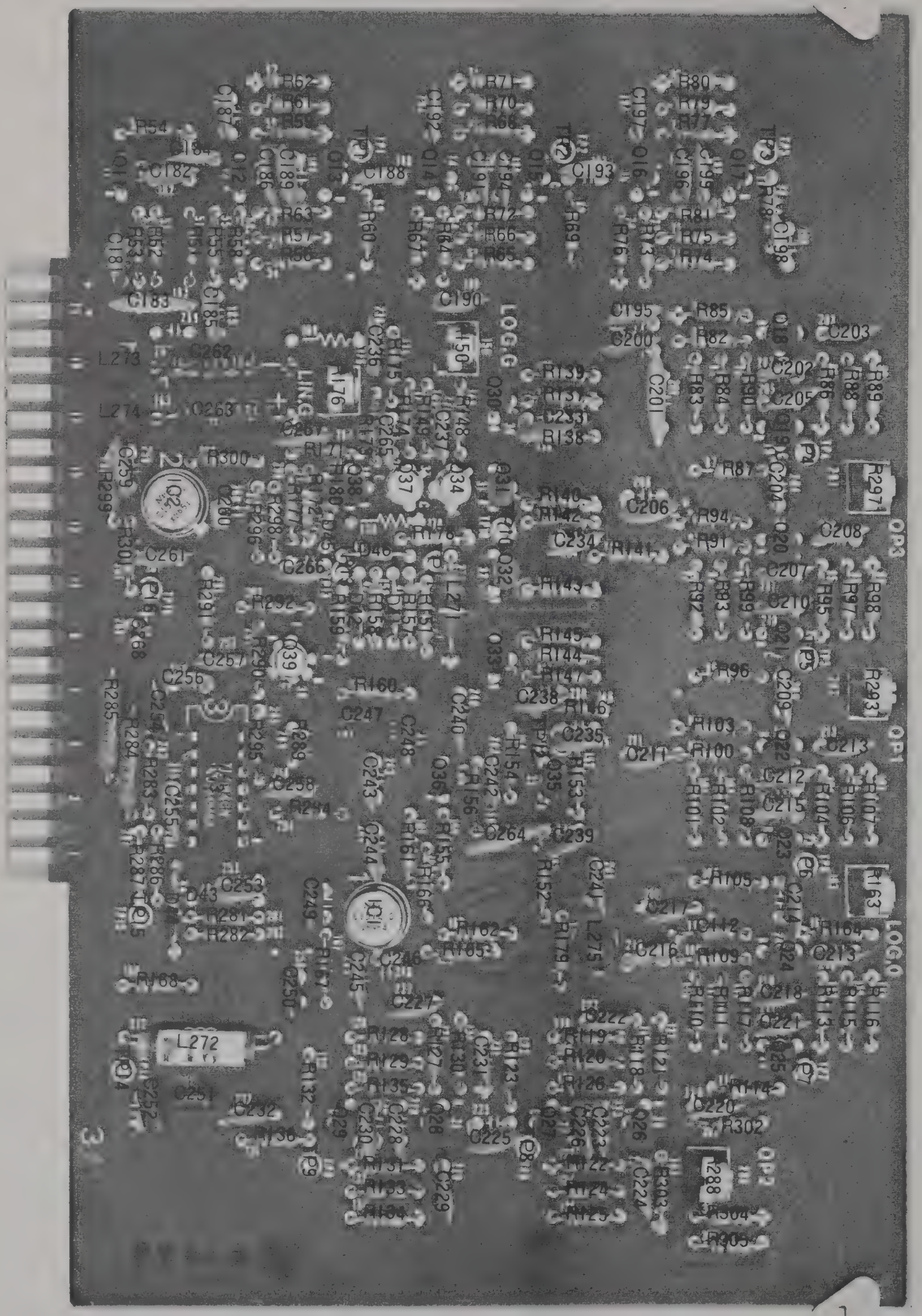
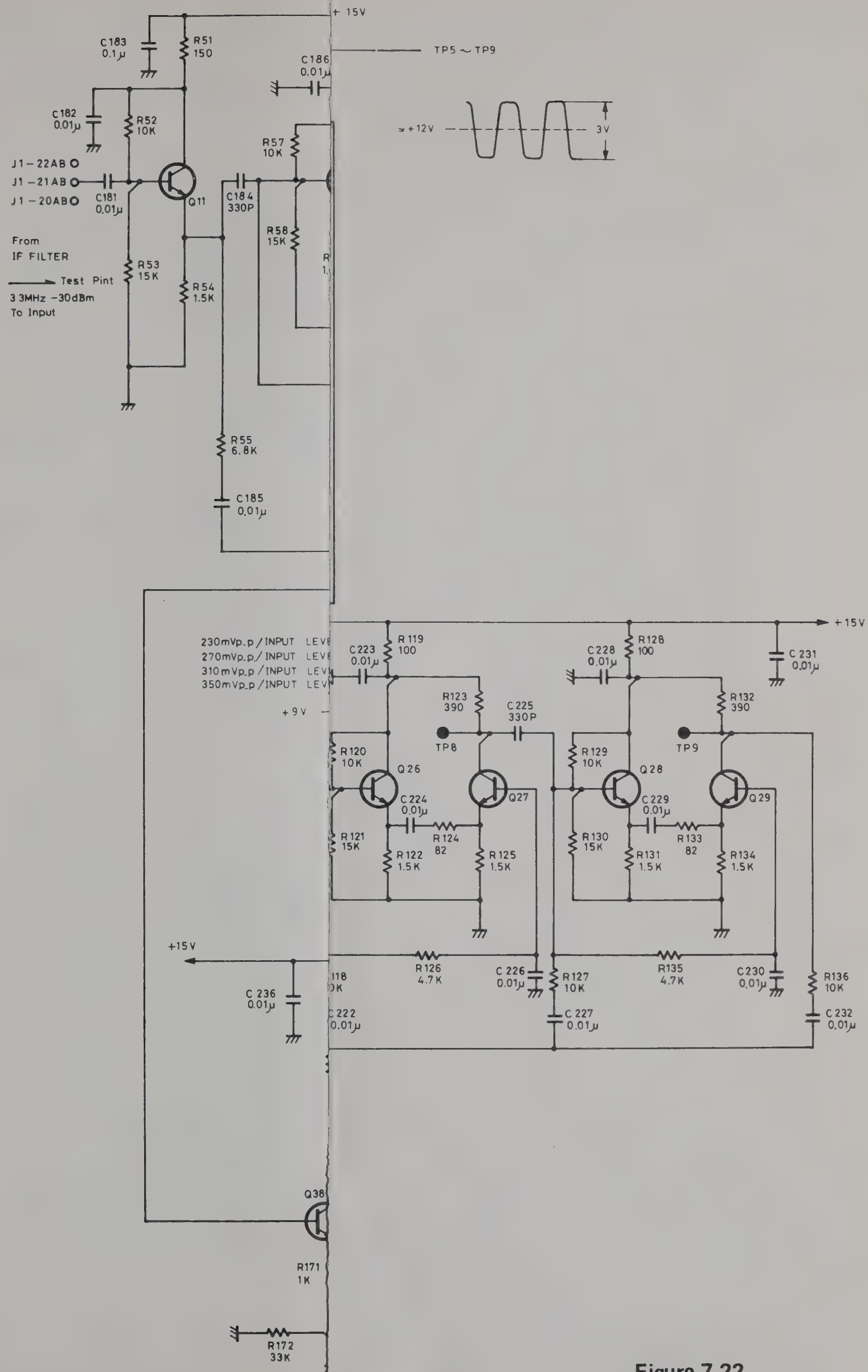


Figure 7.21 LOG AMP Bd LAYOUT (PH209)



0395906 − 008 − B

Figure 7.22
LOG AMP CIRCUIT SECTION I

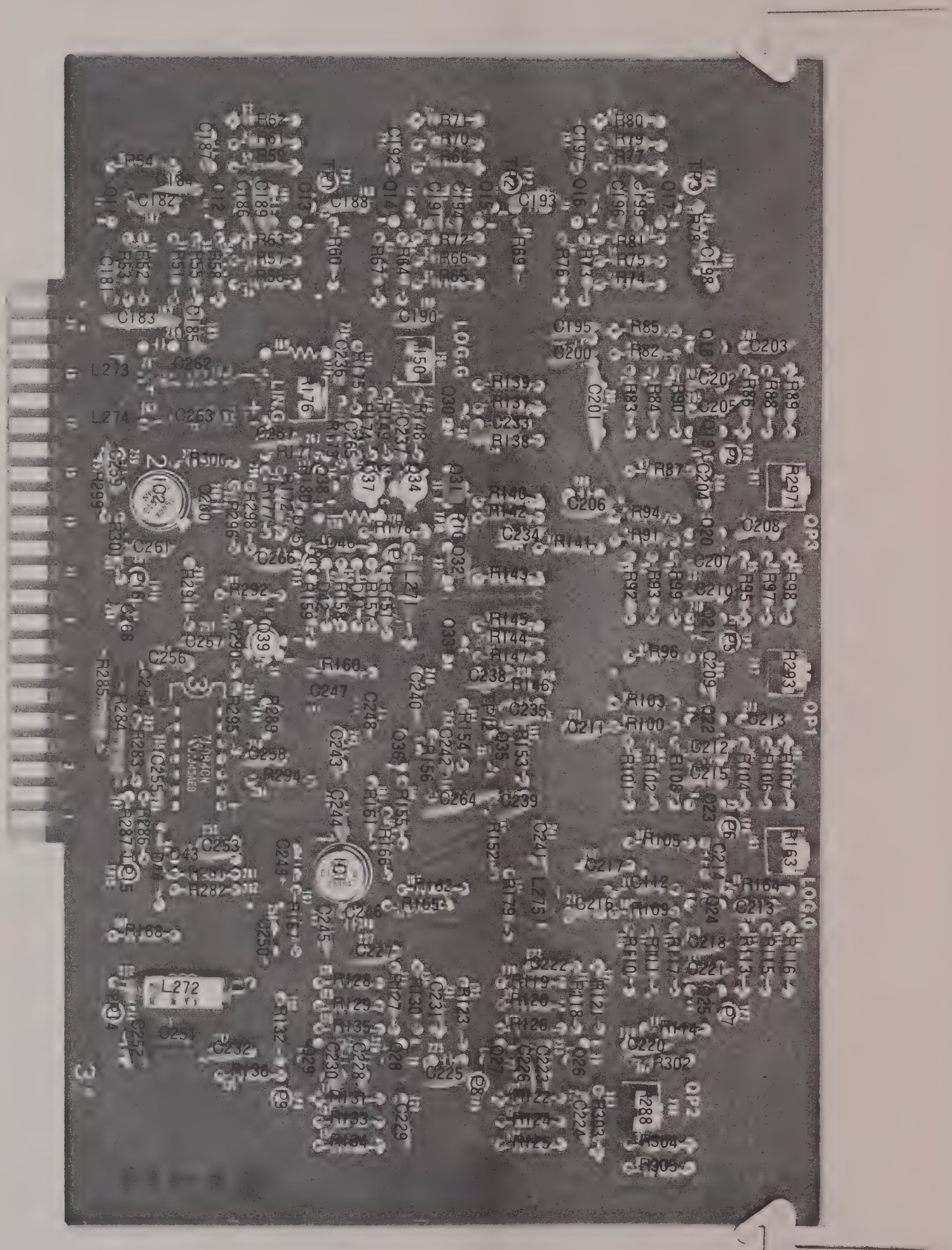


Figure 7.21 LOG AMP Bd LAYOUT (PH209)

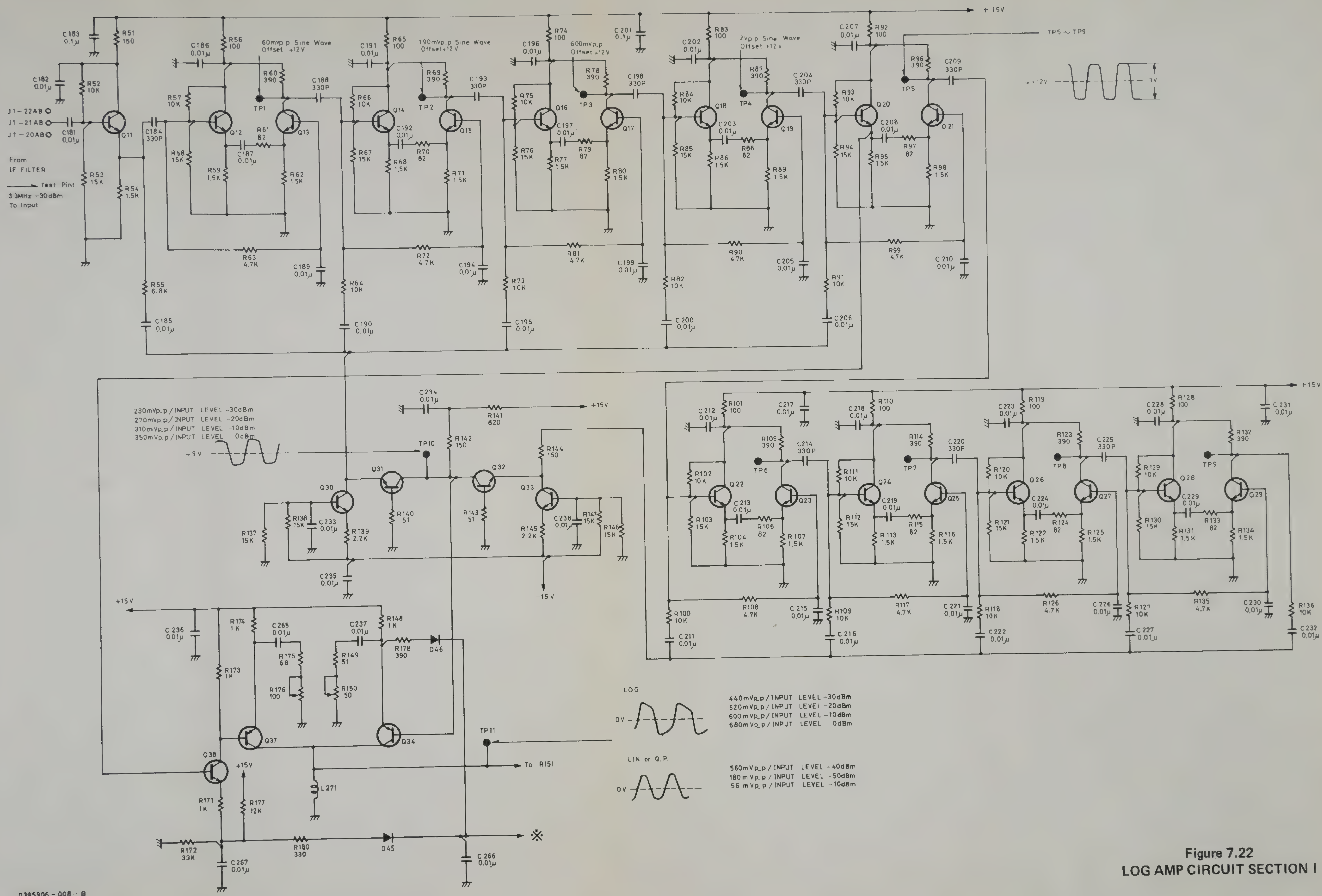
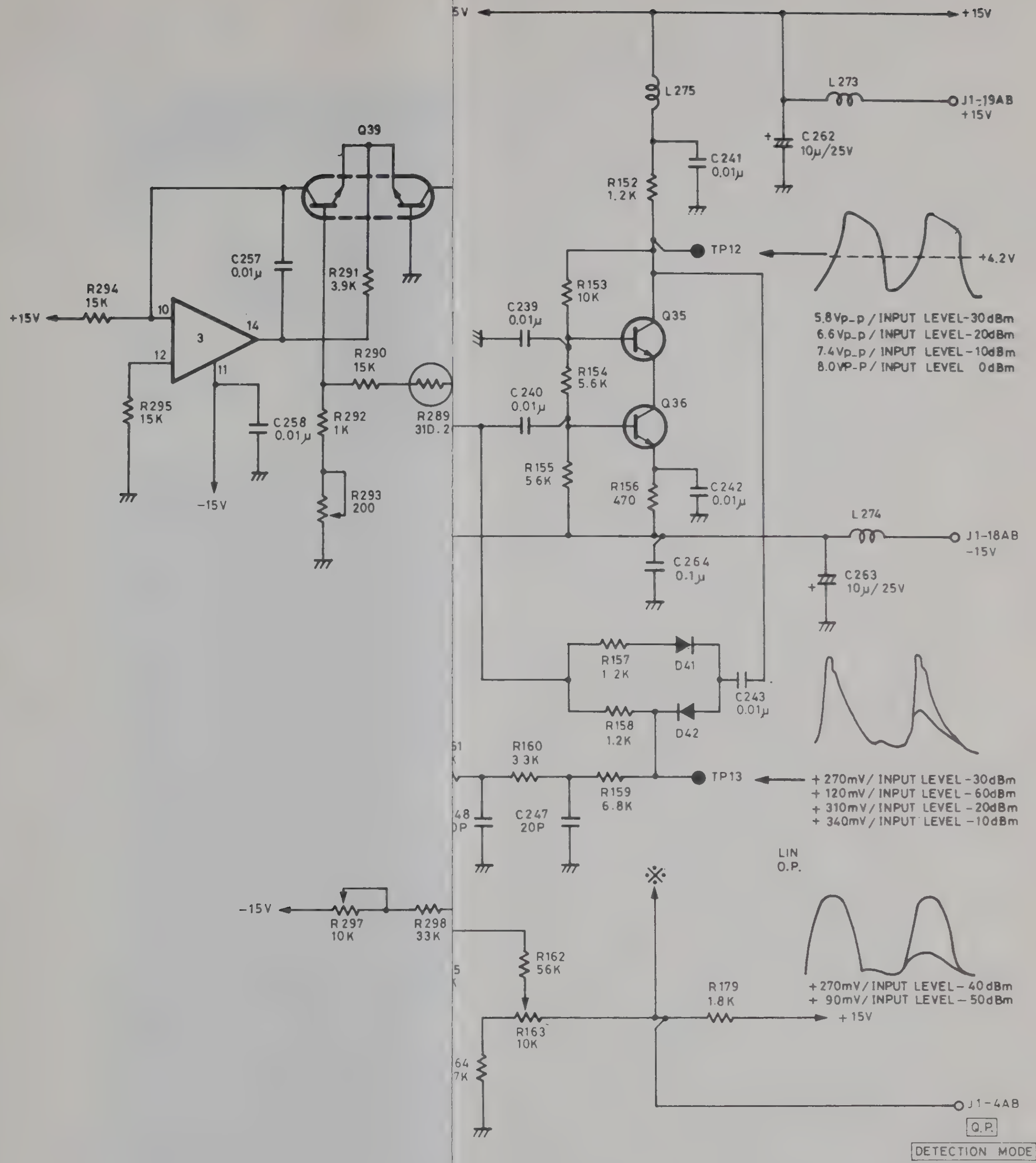
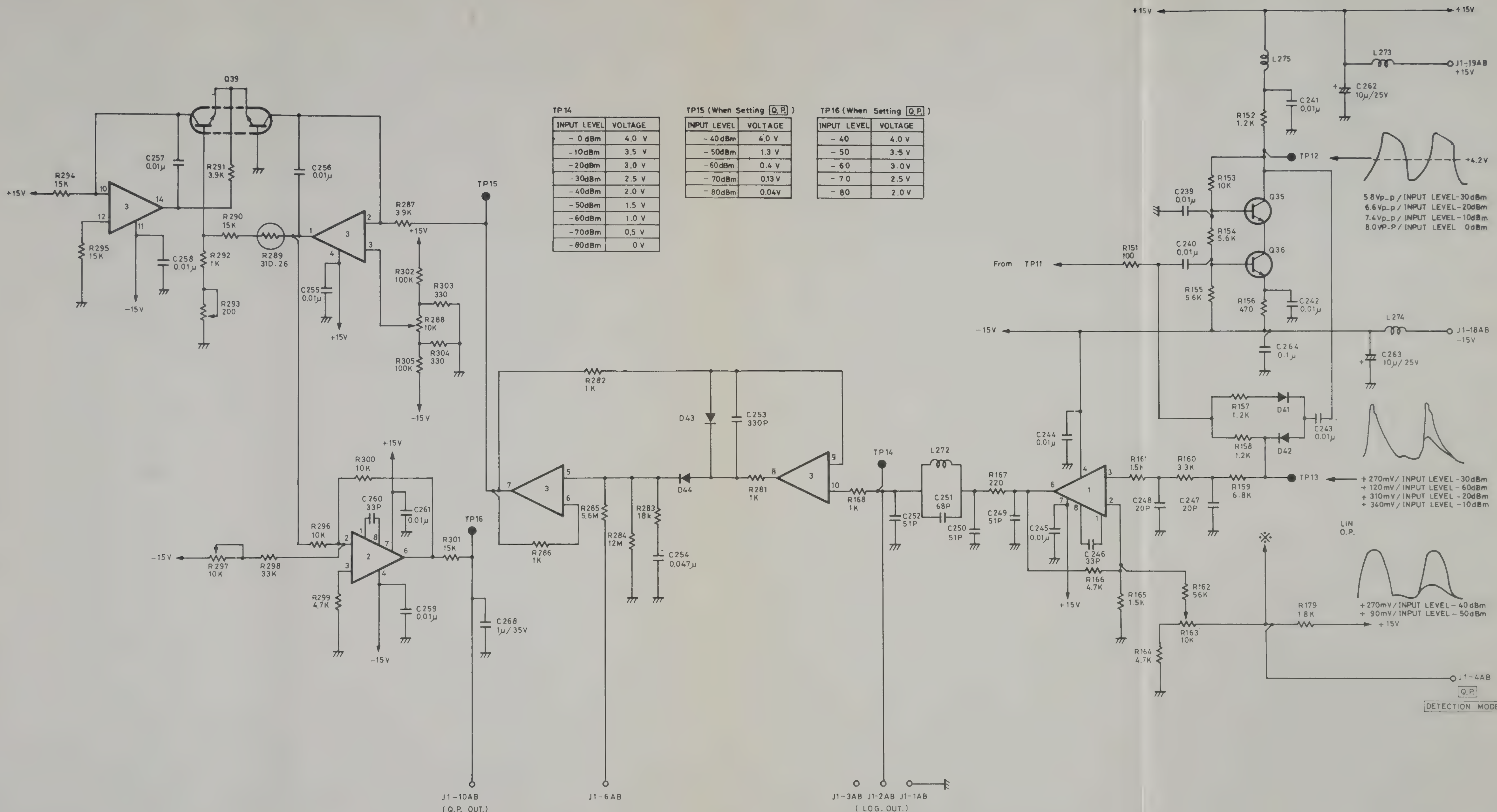


Figure 7.22
LOG AMP CIRCUIT SECTION I



0395906-009- B

Figure 7.23
LOG AMP CIRCUIT SECTION II



TP14

INPUT LEVEL	VOLTAGE
- 0dBm	4.0 V
-10dBm	3.5 V
-20dBm	3.0 V
-30dBm	2.5 V
-40dBm	2.0 V
-50dBm	1.5 V
-60dBm	1.0 V
-70dBm	0.5 V
-80dBm	0 V

TP15 (When Setting Q.P.)

INPUT LEVEL	VOLTAGE
-40dBm	4.0 V
-50dBm	1.3 V
-60dBm	0.4 V
-70dBm	0.13 V
-80dBm	0.04V

TP16 (When Setting Q.P.)

INPUT LEVEL	VOLTAGE
- 40	4.0 V
- 50	3.5 V
- 60	3.0 V
- 70	2.5 V
- 80	2.0 V

0395906-009- B

Figure 7.23
LOG AMP CIRCUIT SECTION II

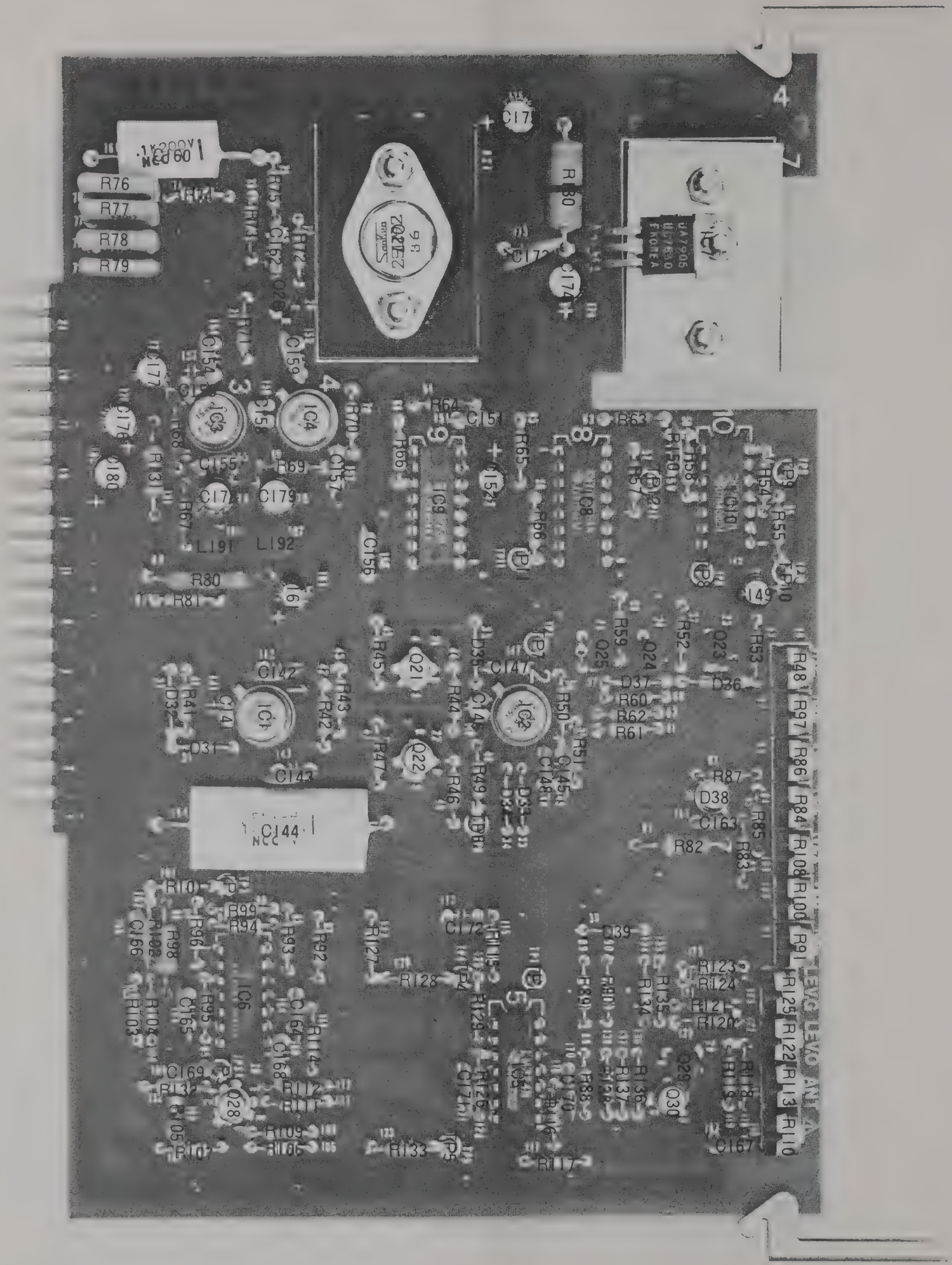
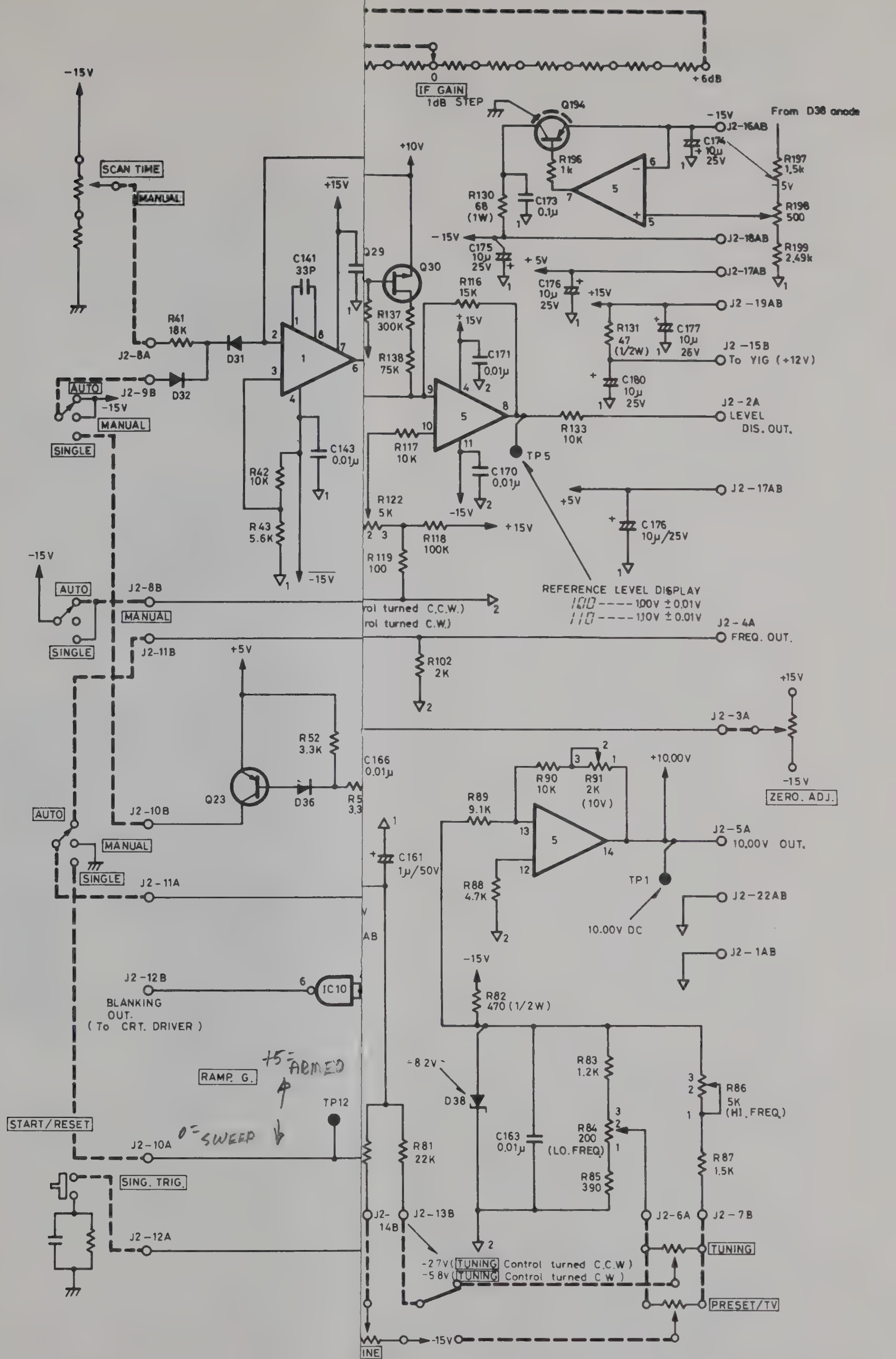


Figure 7.24 RAMP GENERATOR & YIG DRIVER Bd LAYOUT (PF130)



0395906 - 010 - C

Figure 7.25
RAMP GENERATOR & YIG DRIVER CIRCUIT

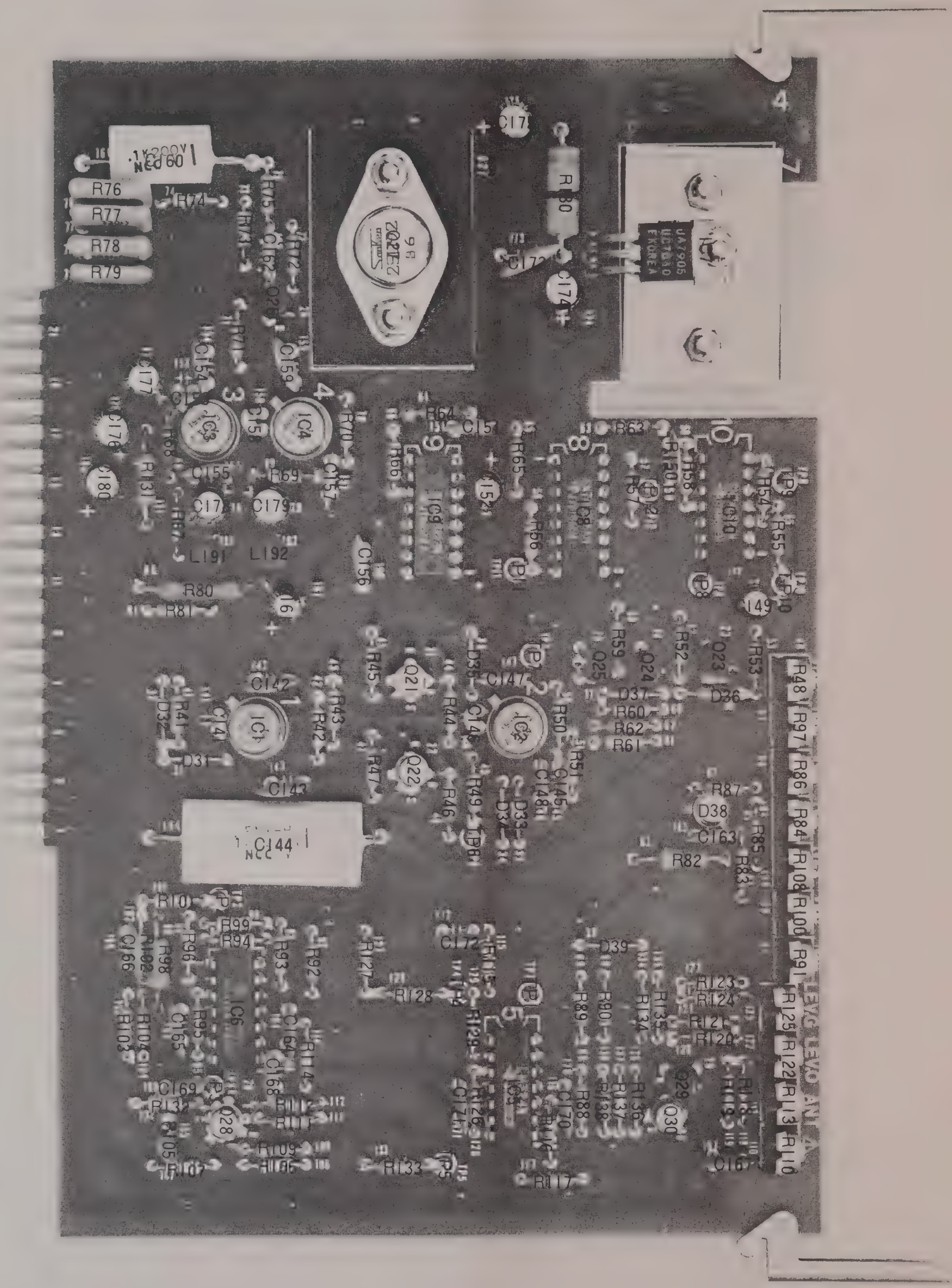


Figure 7.24 RAMP GENERATOR & YIG DRIVER Bd LAYOUT (PF130)

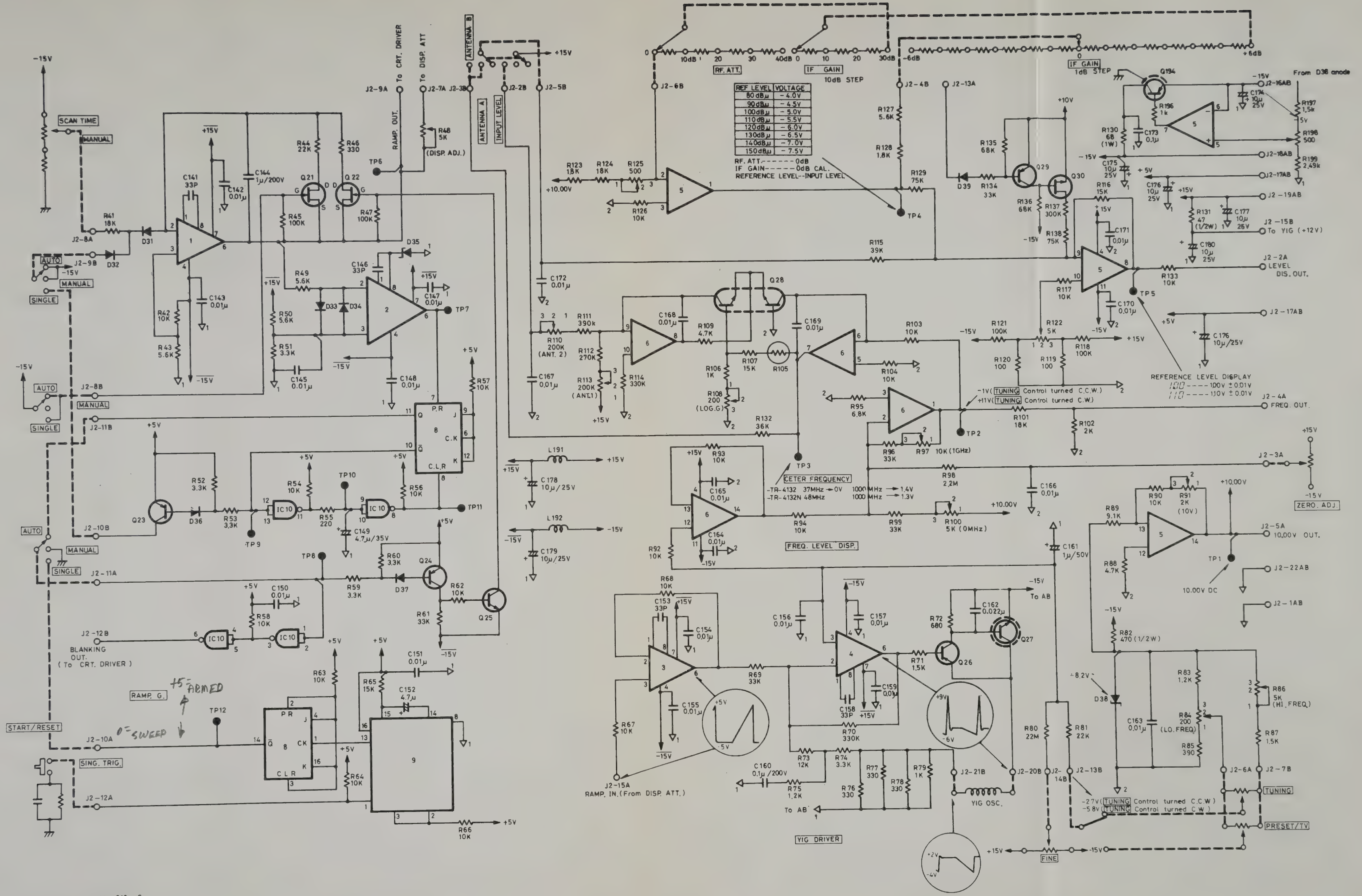


Figure 7.25
RAMP GENERATOR & YIG DRIVER CIRCUIT

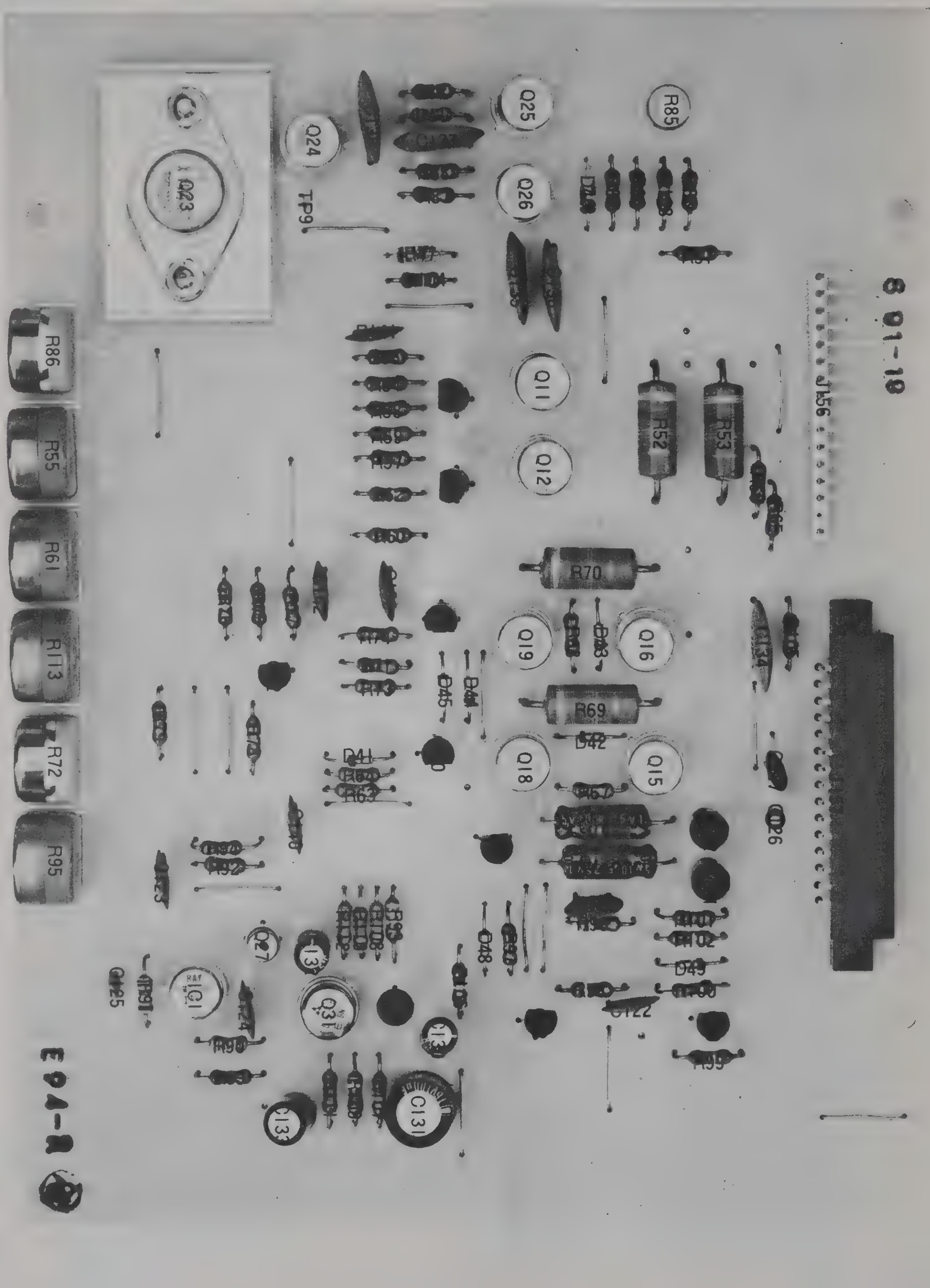


Figure 7.26 CRT DRIVER Bd LAYOUT (SG210)

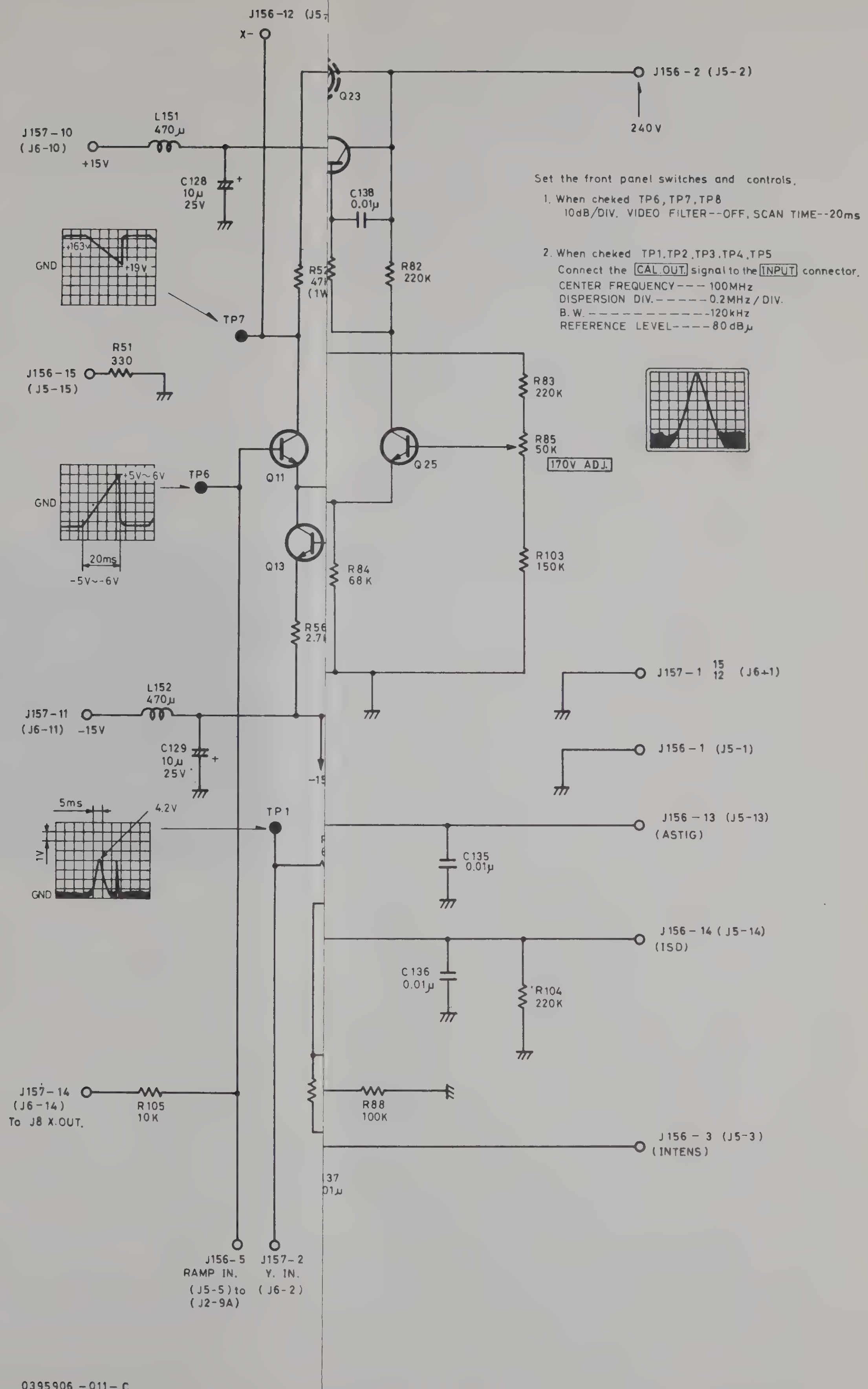


Figure 7.27
CRT DRIVER CIRCUIT

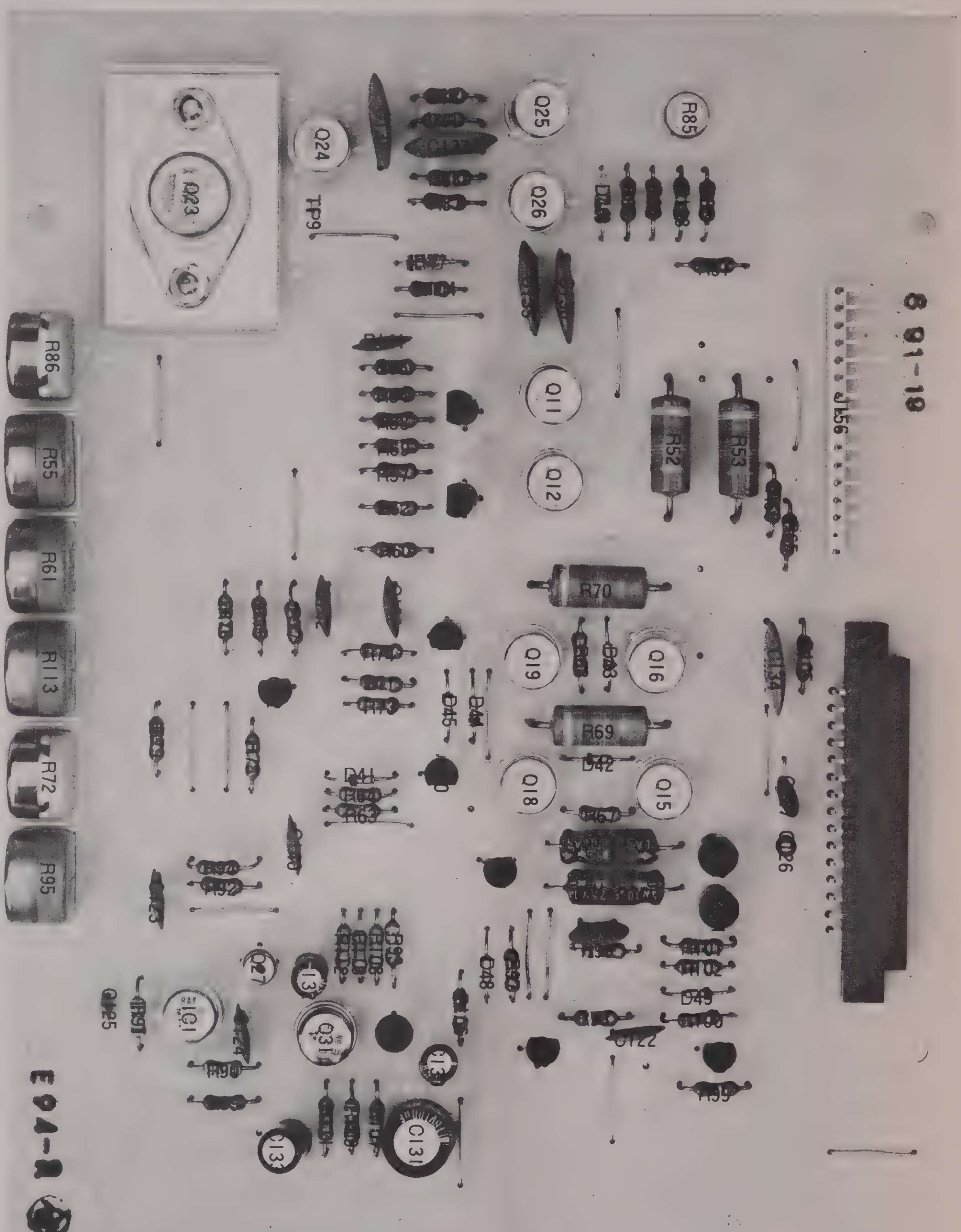


Figure 7.26 CRT DRIVER Bd LAYOUT (SG210)

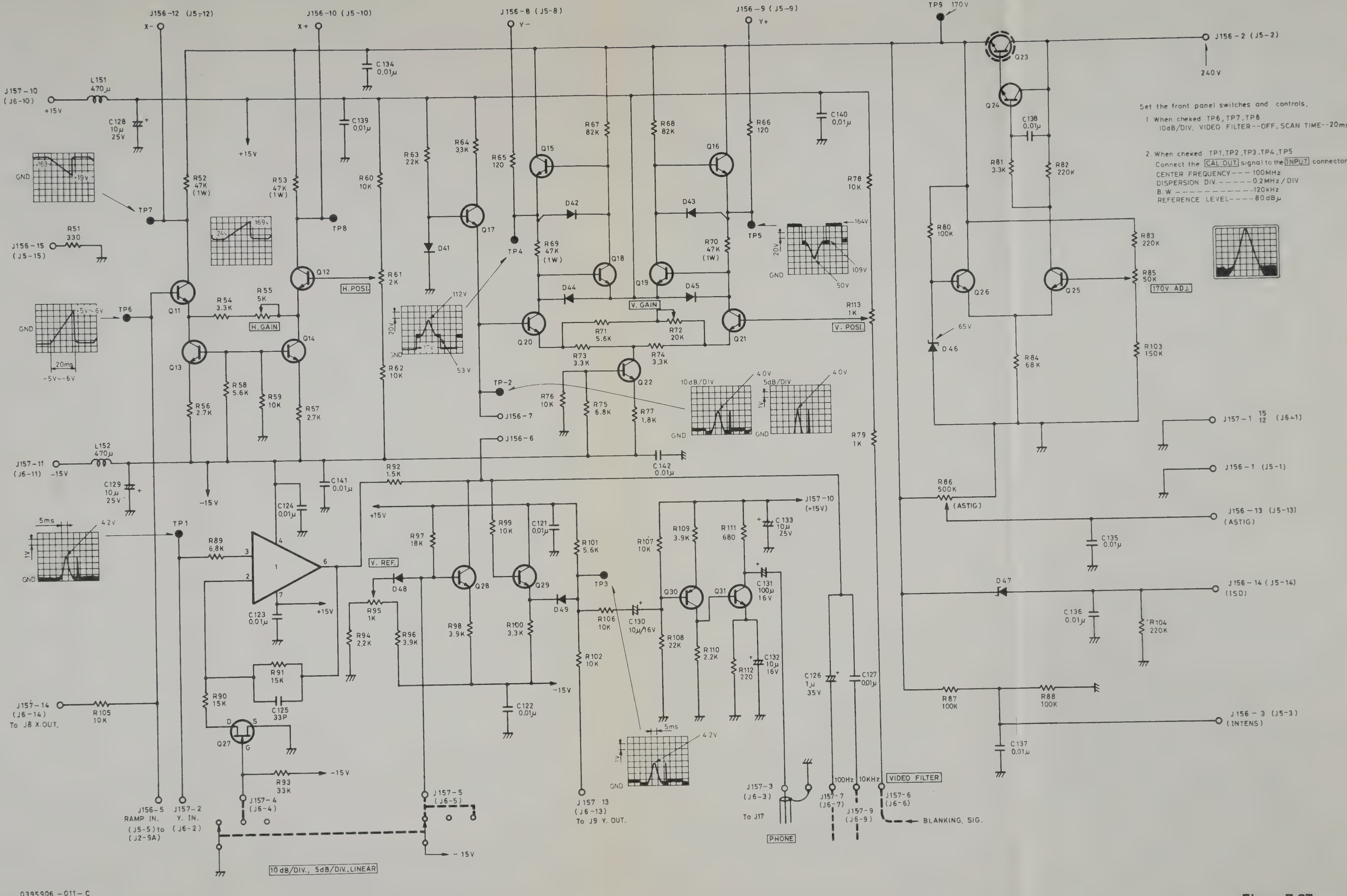


Figure 7.27
CRT DRIVER CIRCUIT

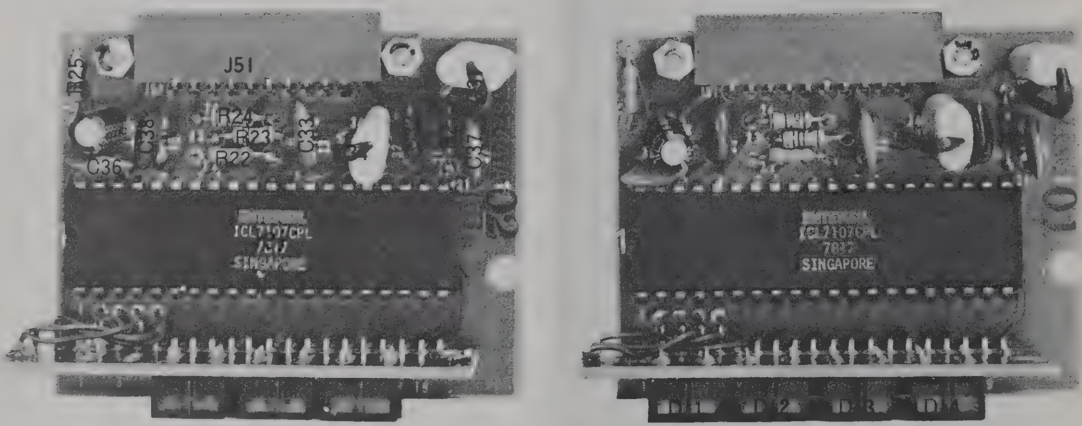


Figure 7.28 DPM ASSEMBLY (SG231, SZ441)

	FREQUENCY DISPLAY
D14	mounted
R 21	100 kΩ
R 25	22 kΩ

0395906 – 012 – B

Figure 7.29
DPM CIRCUIT

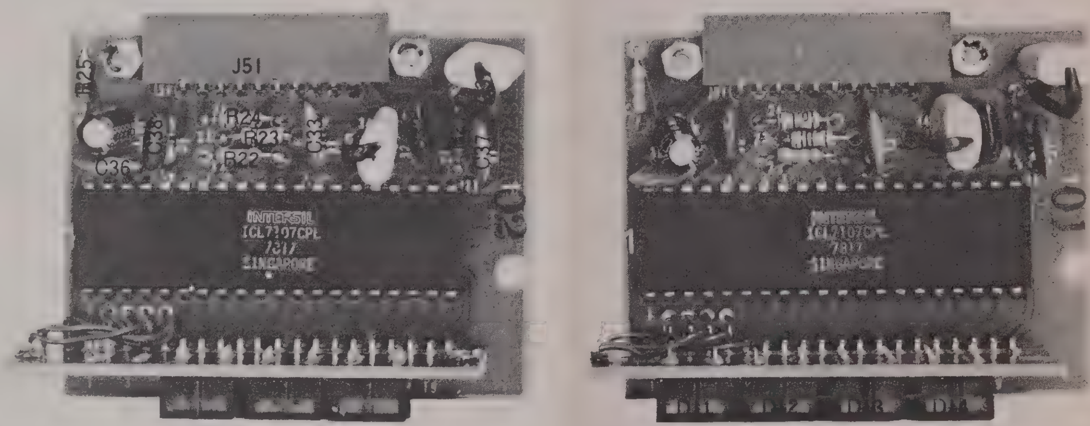
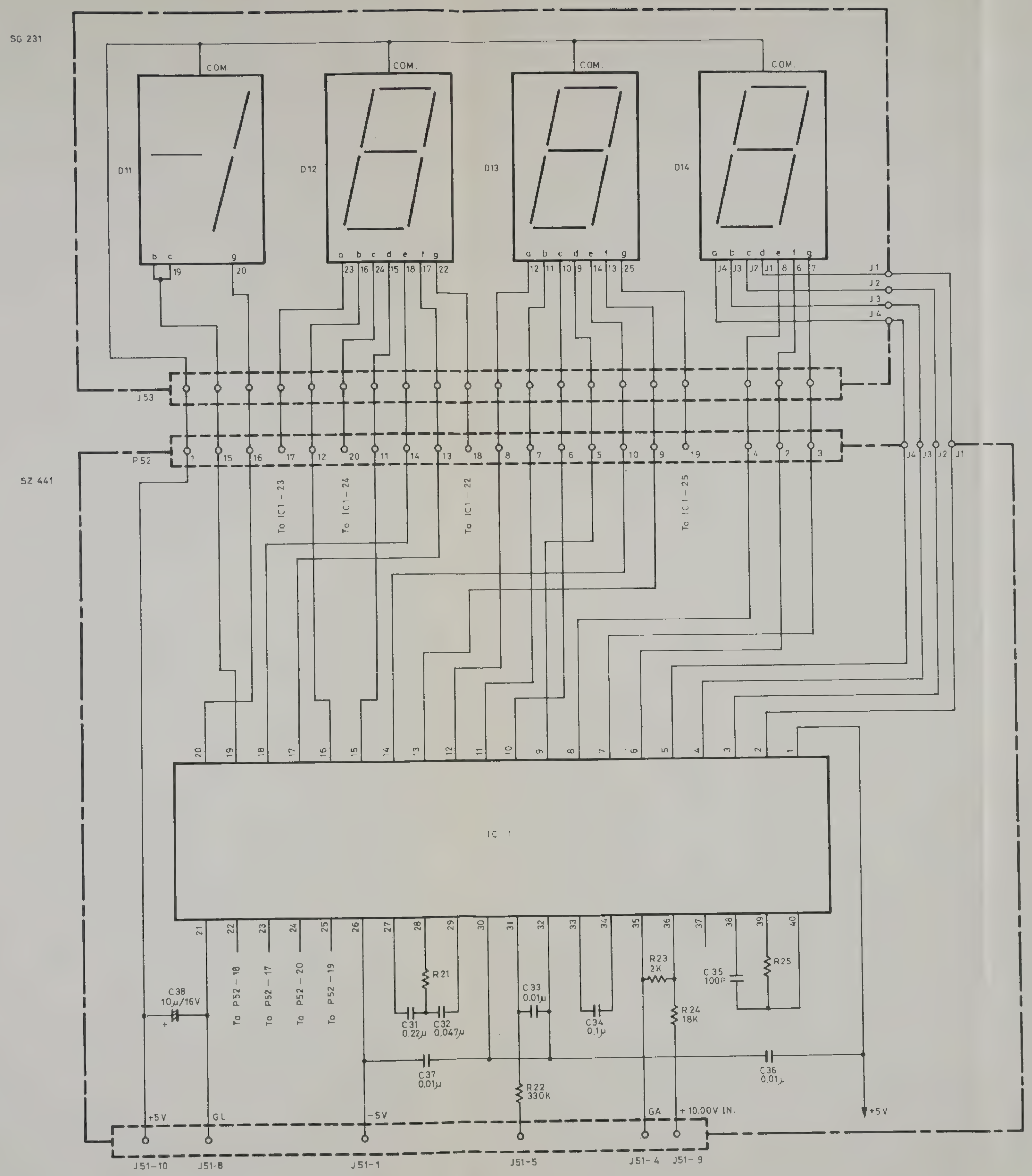


Figure 7.28 DPM ASSEMBLY (SG231, SZ441)



	FREQUENCY DISPLAY
D14	mounted
R21	100 kΩ
R25	22 kΩ

0395906 – 012 – B

Figure 7.29
DPM CIRCUIT

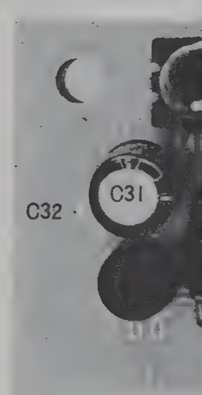


Figure 7.30 CAL C

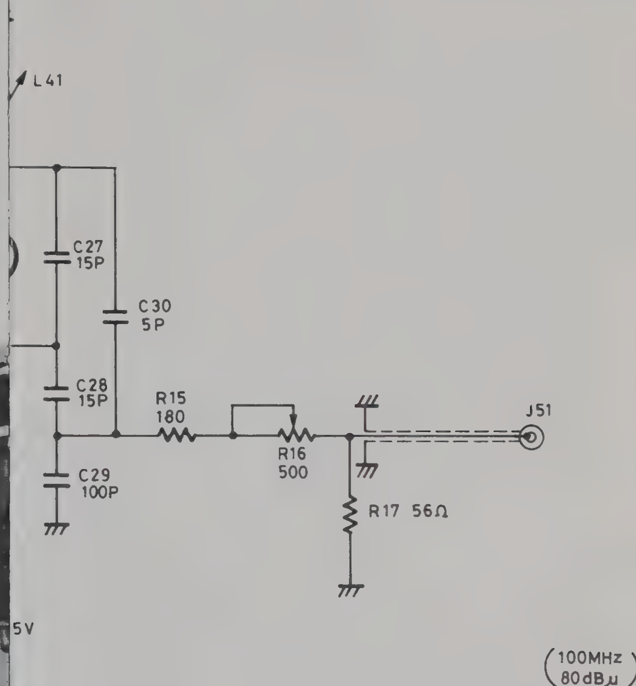


Figure 7.31
CAL OSCILLATOR CIRCUIT

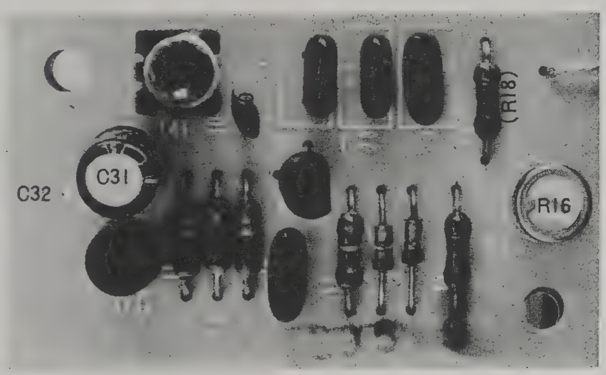
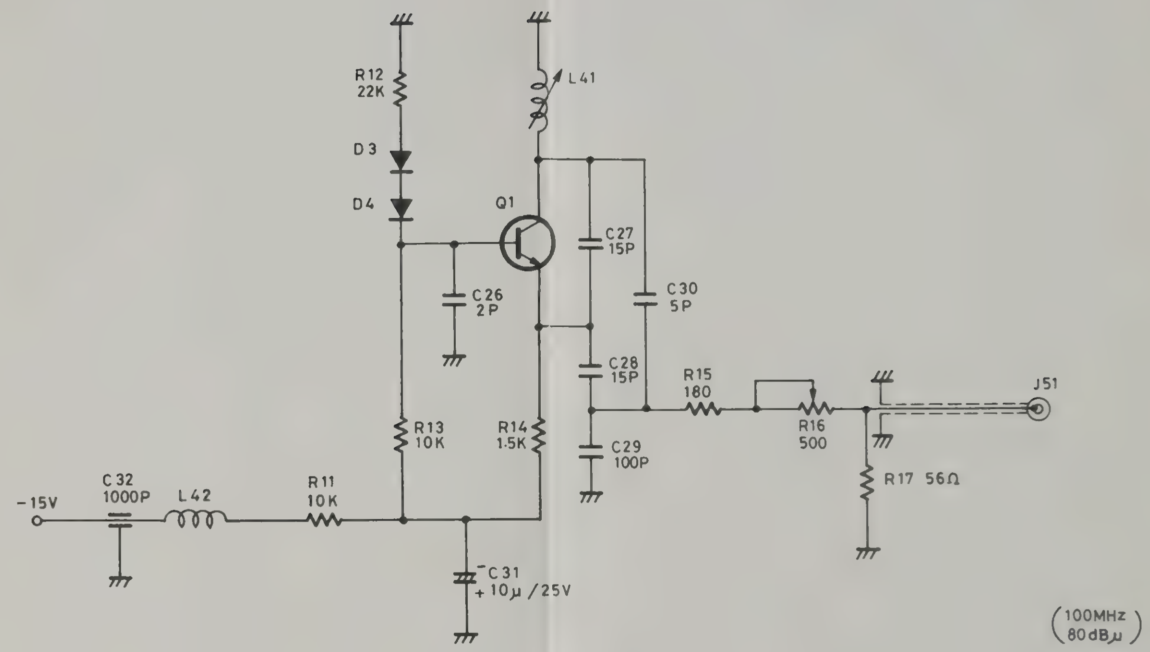


Figure 7.30 CAL OSCILLATOR ASSEMBLY (SF145)



0395906 -013 — B

Figure 7.31
CAL OSCILLATOR CIRCUIT

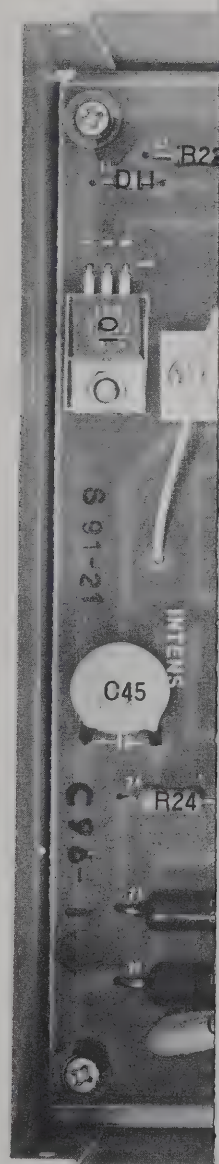


Figure 7.32 HIGH VO

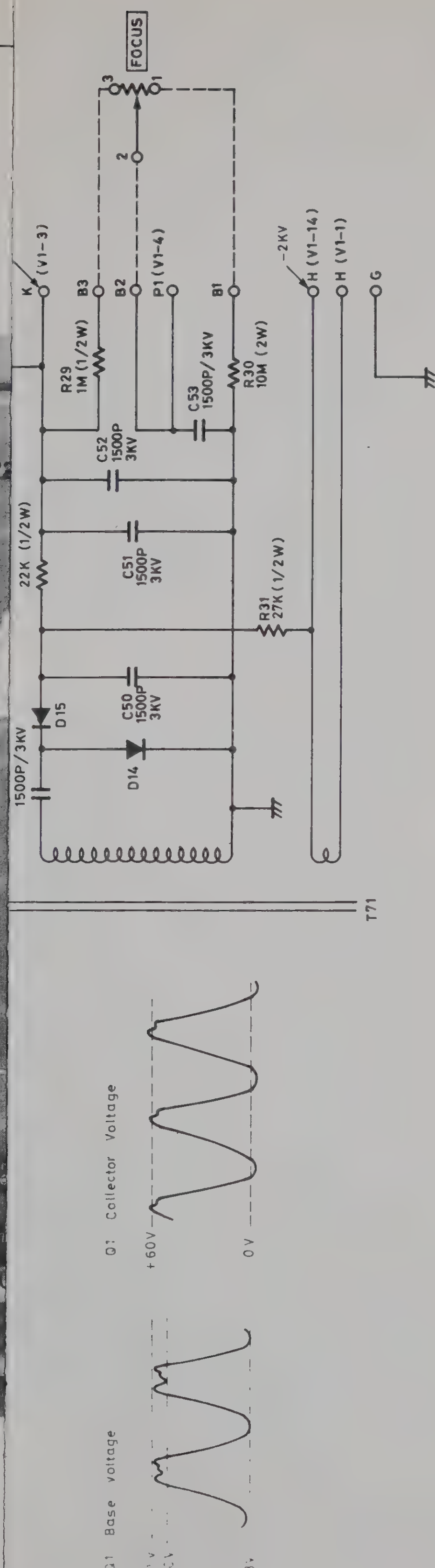


Figure 7.33
HIGH VOLTAGE POWER SUPPLY CIRCUIT

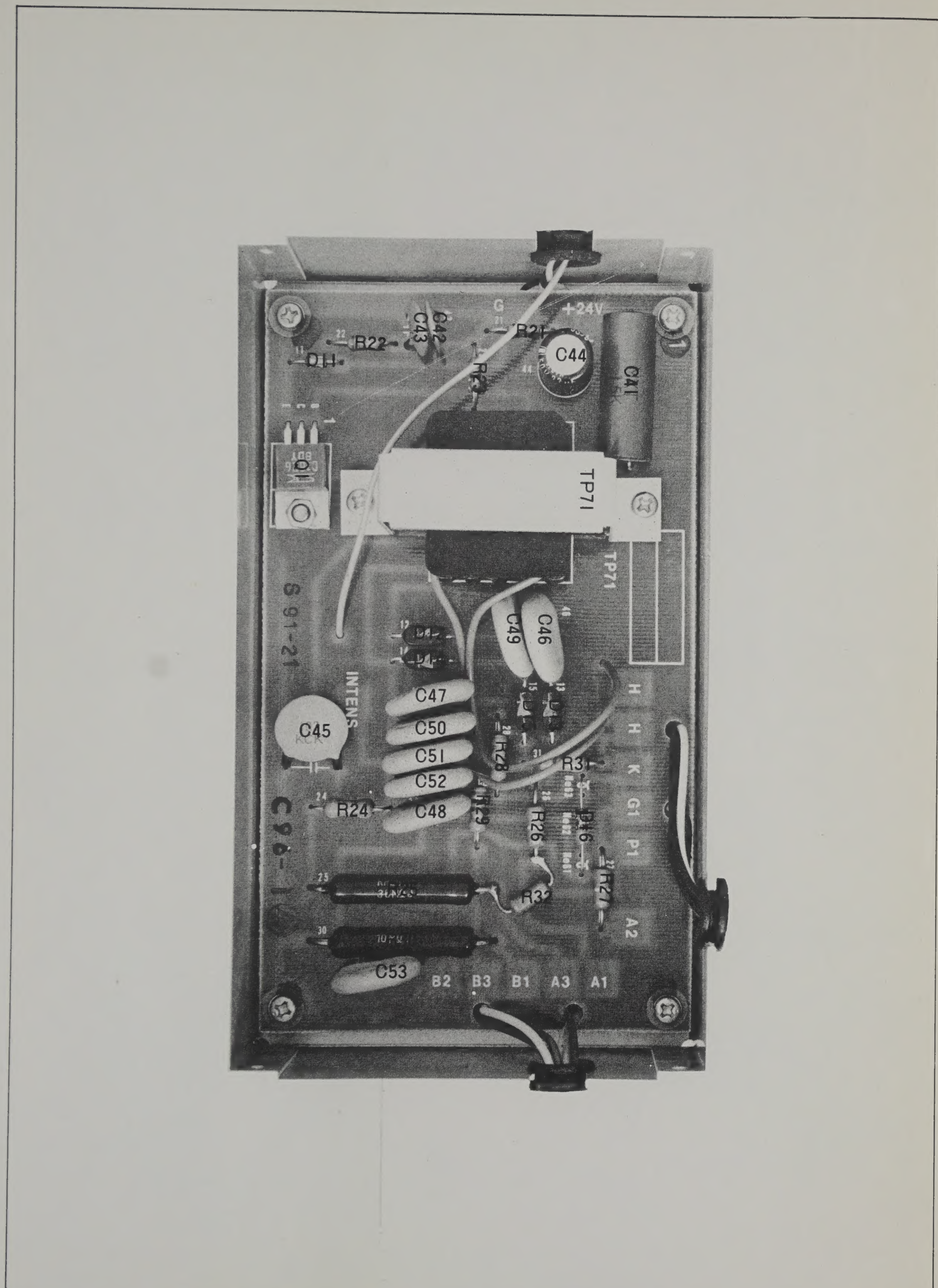


Figure 7.32 HIGH VOLTAGE POWER SUPPLY ASSEMBLY (MEP265)

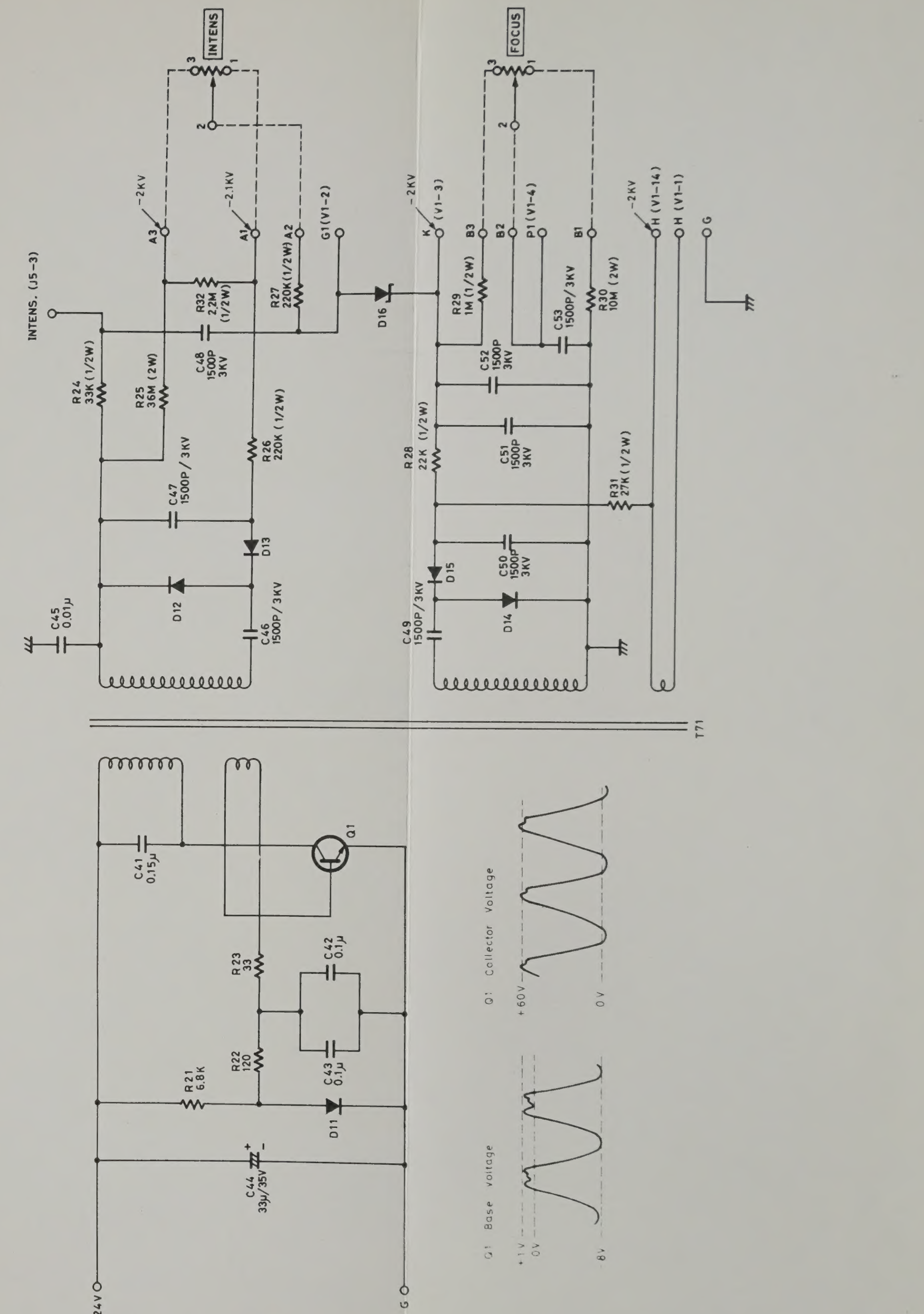


Figure 7.33
HIGH VOLTAGE POWER SUPPLY CIRCUIT